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A Lift Bridge Constructed on 4 Per Cent. Grade

By Charles R. Waters*

A lift bridge of unusual design was put in operation last fall at the Main St. crossing of the Barge Canal in Fairport, N. Y. The old crossing at this point was made by a fixed bridge 80 ft. long, on a skew of about 32°, having a clearance of 12 ft.; the barge-canal construction required a length of 139 ft. and a clearance of 15.5 ft., the elevation of the water being the same in both cases. Economical prism alignment required that the increased width for the new canal be made on the south side, and that the north abutment of the new bridge be located on

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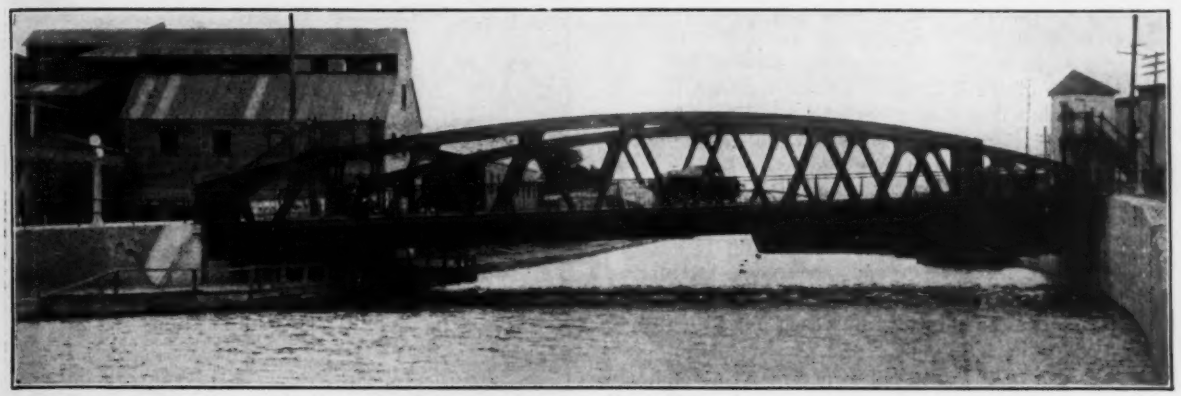

Figs. 1 and 2. Fairport, N. Y., Lift Bridge; on 4% Grade and 32° Skew

(Upper view, finished bridge; lower view, erecting extension girder)

the site of the old abutment. In order not to increase the grade of the north approach, which was already prohibitive (10%), and on account of a railway crossing at the foot of this approach, it was impossible to design a structure of the fixed type. On the other hand, it was desired to reduce the grade of the north approach, and this could only be accomplished by a bridge of the lift type. It was necessary, however, that the south end of the structure conform to the original elevation of the street, on account of its proximity to several village business blocks and also on account of the intersection with West Ave. at the southwest corner. This condition could be met by constructing the bridge on a grade. As the width of West Ave. was reduced one-half by the location of the south abutment, provision had to be made to allow the full width to the street when the bridge is in the "down" position.

After considering these controlling features the type of bridge adopted by the department was a four-post lift, constructed on a 4% grade and at a skew of 32°. The trusses were of the Warren type; but the west truss instead of being designed a through truss for its entire length was shortened about 25 ft. and the remaining distance spanned by an extension girder carrying a 20-ft. roadway shelf in the shape of a triangle. When the bridge is down, its appearance is the same as that of a bridge of the fixed type; the counterweights, lifting frame, etc., are concealed in underground rectangular reinforced-concrete pits. The improvement to Main St. is very marked in that the old north approach has been reduced from a 10% to a 4% grade.

The length of the span between center line of lifting posts is 139 ft.; distance between trusses is 40 ft.; difference in elevation between one end of the bridge and the other is 5.54 ft. Cantilevered brackets on the outside of each truss carry the sidewalks which give an additional width of 10 ft. The total weight of the steel is 350 tons. The extension girder is made up of two plate-girders 58 ft. long, 10 ft. deep at one end and 8 ft. deep at the other, placed parallel, and joined together by diaphragms. The girders are joined to the truss at the second panel-point by riveting the end diaphragm to the lower chord. No other rigid connection is made; the south end of the truss simply rests upon a bearing plate attached to the diaphragm at this point. The truss sits between the girders in such a manner that the top of the flanges on the girder are level with the top of the floor-beams. The floor is composed of two thicknesses of yellow pine, the lower being 4-in. treated timber and the upper a 2-in. untreated wearing surface.

The bridge has a lift of 10 ft. 7 in. It is operated by two 37-hp. motors located under the east sidewalk near the center of the span. The operating shaft runs across the bridge, and the bridge is raised or lowered by two cables (in the lower chord of each truss) which run over sheaves on the end posts and the lifting frame to anchorages in the pit floor and sidewalls.

The moving part of the bridge, which weighs about 375 tons complete, is balanced by two reinforced counterweights (one in each pit). Four 1⅜-in. cables are attached to the counterweights at each corner of the bridge, and these pass over large sheaves on the balancing shaft to the lower chord of the lifting frame. The south weight is about 10 tons heavier than the north due to the additional weight of the extension girder. About 15 tons of concrete blocks are provided for adjustment purposes. The balancing shaft rests on heavy beams which span the pits near the top. The operating machinery has a total weight of 46 tons.

The motors are for three-phase 60-cycle alternating current at 220 volts. The synchronous speed is 600 r.p.m., and the power supply is controlled so as to limit the torque of each motor to 4/3 normal. The average time for raising the bridge is 45 sec. Automatic cutout switches are provided for safety in operation.

The operator's cabin is located near the southeast corner of the bridge and is a two-story frame structure about 10x12 ft. in plan. Stairs are provided for foot travel when the bridge is raised. The pits have reinforced-concrete walls 3 ft. thick and are 10 ft. wide, 53 ft. long, and 28 ft. deep. They have a covering of 12-in. I-beams incased in concrete, with trap-doors at the end posts for access to the machinery.

FIG. 3. UNCOVERED PIT, SHOWING BALANCING SHAFT, CABLES TO COUNTERWEIGHTS, ETC.

Each corner of the bridge and each bearing on the masonry is at a different elevation because of grade and skew; the floor-beams are level at right angles to the truss. The end of the bridge, from one lifting post to the other, is on a 2½% grade, but the lifting posts and the framework are so constructed that the lower chord of the lifting frame is horizontal, and the lifting posts are plumb. The anchorages in each pit are at the same elevation, and the counterweights move vertically in a horizontal position.

The total cost of this bridge to the state, exclusive of the excavation charge, was $75,000. H. S. Kerbaugh, Inc., was contractor, and F. P. Williams, of Rochester, Division Engineer.

Waterproofing Existing Concrete Structures*

The storage works and tunnel connected with the Strawberry Valley Project of the U. S. Reclamation Service are located in the Wasatch Mountains at an elevation of 7500 ft., surrounded by mountains, some of which reach an elevation of 10,000 ft. above sea level. There is a wide variation in temperature in this vicinity during the entire year, and the climate is very severe during the winter months, the lowest temperature on record being 50° below zero. The snowfall ranges from 10 ft. in low years to 24 ft. in high years. On account of these conditions of extreme cold, with alternate thawing and freezing, the action of water and frost on concrete that is not impervious is very marked.

During the first winter after the concrete structures in the Strawberry Valley had been built, the snowfall was very heavy, and the usual wide range of temperature was experienced. During the middle of the day the sun was warm enough to thaw some of the snow lying on the structures, and at night the temperature would go down to anywhere from 20° to 50° below zero; and also the flow of water in the feeder canal would lower, leaving wet surfaces exposed to the extreme low temperature wherever the water came in contact with the concrete. The concrete in the structures had been carefully graded, and inspected when put in, but no attempt had been made to waterproof it and, as a result of it being slightly pervious to water, many of the concrete faces that were exposed to the fluctuations of the surface of the water scaled badly. This was particularly true around the concrete piers between gates.

An inspection of the structures in the spring indicated that some sort of waterproofing should be applied, in order to avoid the necessity of constantly making expensive repairs. A study was made of the various waterproofing processes in common practice, and since the structures were completed it was decided to treat the concrete with some sort of preventive against absorption of water by the surfaces exposed, and in view of the conditions, it was decided to treat the vertical surfaces with alum and soap solutions and the horizontal ones with paraffin.

Materials and Methods

The alum solution was made by dissolving 2 oz. of alum in one gallon of hot water. The soap solution was composed of ¾ lb. of castile soap dissolved in one gallon of hot water. The paraffin was boiled to rid it of any water content, as the presence of water rendered it hard to apply. Ordinary commercial products were used.

Paraffin—The surface to be treated was first entirely freed from all moisture, loose concrete, dirt or other foreign substances. The paraffin was then heated and applied to the surface of concrete with a paint brush, and was forced into the pores by flashing the flames of a blow torch over the surface.

Alum and Soap—The result required in this application was to cause an insoluble stearate to be formed in the pores of the concrete by mixing the soap and alum solutions. In this process the surface of the concrete was prepared in the same manner as for the paraffin treatment. The alum solution was then applied at a temperature of 100° F. with a moderately stiff brush, and was worked in with a stiff horse-brush. While the surface was still moist from this treatment the hot soap solution was applied in the same manner as the alum solution. One treatment with each solution in the manner described above constituted a coat. If other coats were deemed necessary, they were applied in a manner similar to the first coat, after the preceding coat had been allowed to stand 24 hours or more. The work of application was carried on by two men, one applying the solution and the other following and working the same in as described above.

Costs

The two men engaged in this work received compensations of $75 and $80 each per month. The cost of waterproofing materials was as follows: Cudahy's Genoa Brand of castile soap at 12½c. per lb.; alum at 18c. per lb.; and crude paraffin at $4.80 per cwt. Necessary brushes cost $6.06.

Twelve structures in all were treated, the surface area covered being approximately 28,000 sq.ft. Four thousand feet of this was treated with paraffin at the rate of one pound for 11¾ sq.ft., and the remainder with alum and soap. It required one gallon of alum solution and a half a gallon of soap solution to cover 50 sq.ft. with two coats. On an average two coats of alum and soap were applied at a total cost of 76c. per 100 sq.ft., and ranged from 41c. for the lowest to $1.28 for the highest. The cost of one coat of paraffin ranged from $1.70 to $3.78 per 100 sq.ft. and averaged $2.11. This cost covers everything except general expense. One coat of paraffin was all that could be applied, as the concrete would not absorb more, nor could any more be forced into the pores by heating.

Results

No actual tests were made to determine the imperviousness of the concrete after treatment, but the structures that were repaired and treated have gone through two severe winters and no further disintegration of the concrete on any part has occurred, and thus the results obtained by this style of waterproofing may be considered entirely satisfactory. It is believed that waterproofing of some kind is absolutely necessary in connection with the building of concrete structures where they are exposed to the kind of weather conditions that prevail in the Strawberry Valley, in order that the life of the structure may be prolonged without expensive repairs. The concrete piers between the gates were repaired and waterproofed and no disintegration whatever has been observed since on them.

The above work was in charge of J. L. Lytel, Project Manager, Strawberry Valley Project, Provo, Utah.

*From information furnished by the U. S. Reclamation Service.

Electric Motor Omnibuses are being run by the City of York, England. The vehicle seats 22 passengers and weighs, with the storage battery, about 8000 lb. The battery used comprises 64 Edison cells, is placed under the seats, and has a capacity of 300 amp.-hr. at 72 volts. The omnibus can run at speeds from 10 to 12 miles an hour and can make 40 to 45 miles before recharging. One advantage of the electric omnibus is that it requires so little attention from the driver that he is able to act as conductor as well as motorman. The entrance door is at the front, beside the driver's seat, and by running without a conductor the operating cost is greatly reduced.

A Three-Level Railway Crossing at Chicago

The comprehensive system of track elevation for the elimination of railway grade crossings of streets in Chicago is complicated at some points by the existence of railway track crossings at the street level. Some of these are retained as track crossings, but removed above the street level. Others are eliminated by raising one of the intersecting lines to cross the street and raising the other line to a sufficient height to carry it across the lower elevated line as well as the street. An interesting case of this latter class is the crossing of the Chicago, Rock Island & Pacific Ry. and the Chicago & Western Indiana R.R. at 79th St. (Auburn Park), which was originally planned as belonging to the former class of crossing. It forms a part of the track-elevation scheme of the C., R. I. & P. Ry., described in our last week's issue.

The two railway lines intersect at an angle of about 17°, which will be modified to about 22° in the new work. The street will be lowered about 7 ft. below the normal level (with approach grades of 3%). The Chicago & Western Indiana line will be elevated about 10 ft. (or to 17 ft. above the new street level), giving a clearance of 13 ft. 6 in. in the subway. The Rock Island line will be elevated about 33 ft. above the present level (or 40 ft. above the street at the crossing), giving a clearance of 17 ft. above the tracks of the other road.

This crossing under construction is shown in Fig. 1, with the old grade crossing at the right, and three of the five spans of the high-level line erected. The Rock Island tracks are on the far side of the watchman's cabin, while the Western Indiana tracks are in the foreground and on a curve. These latter tracks (ten in number) will run through between the piers, being raised to about the level of the top of the pyramidal footings of the piers. At the right is a locomotive crane setting one of the main girders, and at the left is the hollow abutment, above which rises the elevator tower and chute of one of the concreting trains. The general layout of the crossing is shown in Fig. 2.

The work is being done without interruption to traffic, although 450 to 500 trains pass over the crossing daily. The tracks were diverted and the crossing shifted tem-

FIG. 1. HIGH-LEVEL VIADUCT OF DOUBLE-DECK CROSSING OF THE ROCK ISLAND LINES AND CHICAGO & WESTERN INDIANA R.R. AT 79TH ST., CHICAGO

(The present tracks are at the street level. The five Rock Island tracks will be on the five-span girder bridge. The ten Western Indiana tracks will pass beneath this bridge, but raised to about the level of the tops of the cars shown so as to pass over the street)

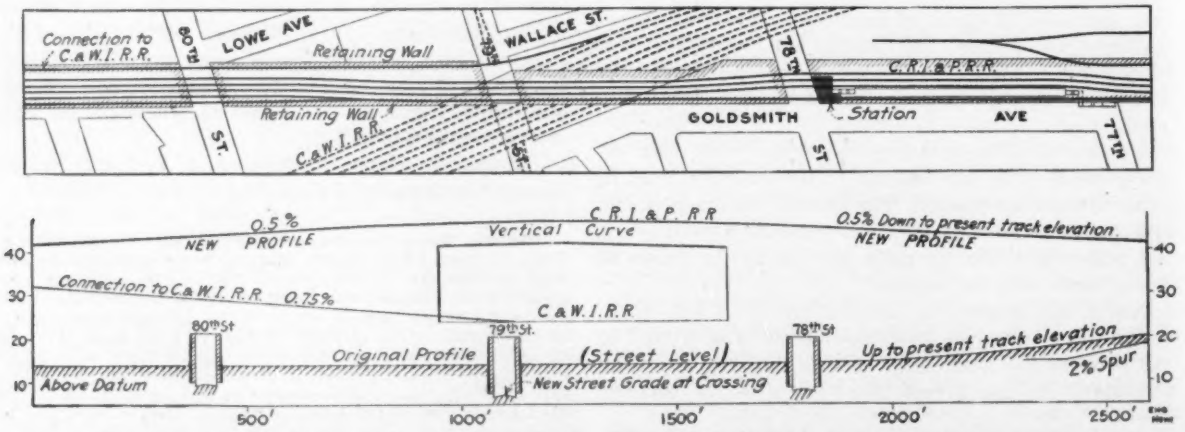

FIG. 2. PLAN AND PROFILE OF DOUBLE-DECK TRACK CROSSING AT 79TH ST., CHICAGO

porarily, so as to leave the east side of the right-of-way clear for the construction work. The structure will be built first for three tracks, with a temporary approach of 1½% grade at the south end. When this portion is completed traffic will be diverted from the surface tracks to the elevated tracks, and construction work prosecuted on the west side of the right-of-way for the other tracks. During the progress of the work the switches and signals are operated by hand.

The original crossing had four tracks for the C. & W. I. R.R. and three for the Rock Island Lines, but the new crossing will have ten and five tracks respectively, with an interchange connecting track on a grade of 0.75%, as shown in Fig. 2. The number of trains over the crossing is 464 per 24 hr., about equally divided between the two lines, while the work-train movements bring the total to about 500 trains in all. This heavy traffic constitutes one of the difficulties encountered in carrying on the work rapidly and economically, but the regular traffic is being handled practically without interruption.

The viaduct at the street crossing is a double-deck structure, as the point of intersection of the two railway lines is just north of the street. The structure carrying the lower line will have a row of columns on each curb line and in the center of the street, capped by box-girders supporting a deck of longitudinal I-beams with a concrete deck and ballasted floor.

The Rock Island line has a viaduct of five through-girder spans of 85 to 90 ft., with a total length of 630 ft. Owing to the skew location and the width of the five-track bridge, it was necessary to adopt a steel superstructure. There are two lines of girders, 74 ft. apart on the square, but nearly 200 ft. measured along the piers. They are carried partly on concrete piers and partly on steel cross-girders and columns. This complicated construction is shown in Fig. 3.

The piers are very high, being carried to foundations well below the level of the lower track, and are reinforced throughout. Their design is shown in Fig. 4. In the coping is embedded a steel bolster composed of two 15-in. channels and top cover-plate, to which are bolted the seats for the steel floor-beams. They are designed for Cooper's E-55 loading, and a tractive force of 16% of the live-load on a 90-ft. span. The assumed wind load is 30 lb. per sq. ft. on the girders and piers (acting at right angles to the piers); and for the train a wind load of 400 lb. per lin. ft. of track, applied 7 ft. above the rails.

At the street crossing, the ends of the piers are incorporated in the abutments of the span for the low-level bridge. To support the floor-beams across the street, three lines of deck-girders are placed in line with the piers, bridging the gap over the street (Fig. 3). This part of the structure requires two columns in the street, but these are so located as to be combined with the columns of the low-level span. These columns are founded on concrete piers built in open wells carried down to solid rock.

The abutments are of unusual design (Fig. 5). Instead of being in the form of a retaining-wall with solid fill behind, each abutment is a long narrow hollow structure, the two parallel walls being pierced with openings and supporting a slab deck over the interior space, through which extends the slope of the fill. This construction, shown in Fig. 5, was adopted as being cheaper and giving a better distribution of load than a single abutment of large height, the height from top of footing to rail level being about 30 ft.

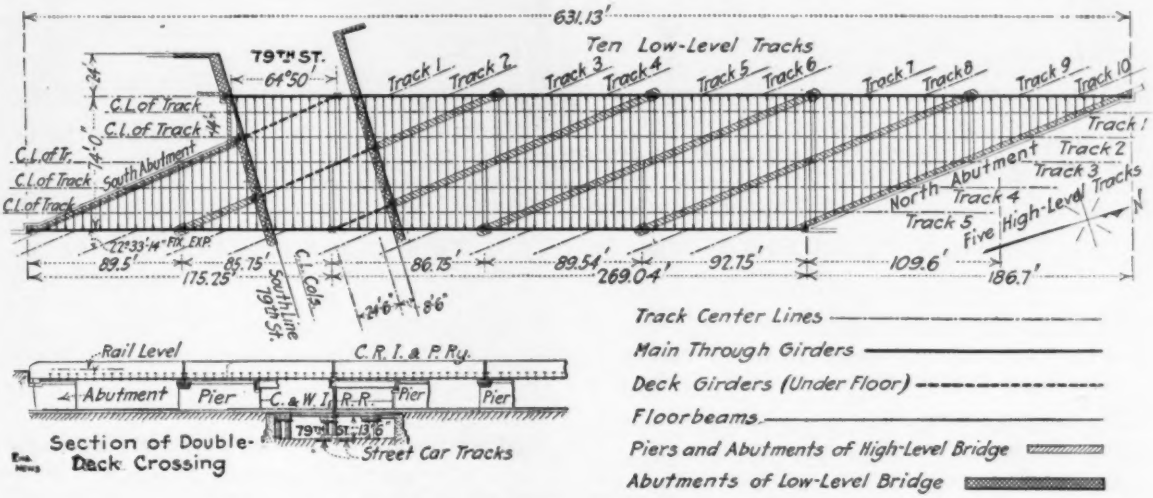

FIG. 3. PLAN AND ELEVATION OF 79TH ST. BRIDGE; ROCK ISLAND LINES

The floor system consists of plate-girder floor-beams 28¼ to 32¼ in. deep, with spacing from 38 in. to 64 in. Owing to the skew, many of them have one end carried by a girder and the other by a pier (Fig. 3). A pair of Z-bars riveted along the web serve as the support for the deck slab. The girders, shown in Fig. 6, are of very heavy construction, with top and bottom cover-plates, four reinforcing plates and four flange angles. The floor-beams, girders and columns were all incased in concrete, applied with the compressed-air "cement gun." This coating is about 1¾ in. thick for the webs, 2 in. for the bottom flanges of the floor-beams and 3 in. for the flanges of the girders. It is reinforced by wire mesh and by steel rods carried in holes in the stiffeners. A box-car fitted with a broad platform served as a traveler for this work. The platform was carried by long timbers laid across the roof, with inclined braces from the car sills to the ends of the timber.

The bridge floor (Fig. 6) is a reinforced-concrete slab 16 in. thick, inclosing the upper part of the floor-beams. Beneath this is a 5-in. slab at the level of the bottom flanges, leaving air spaces between the floor-beams. At the ends of the spans, where an expansion joint is left in the floor, this joint in the lower slab is covered by a 2-in. slab of concrete. Upon the top of the concrete floor is a waterproofing course of felt and pitch; this is carried up 6 in. at each side and secured in a notch in the concrete casing, so as to prevent any water from getting beneath it.

The steel girders, weighing about 44 tons each, were shipped complete and hoisted into place by locomotive cranes standing on the tracks below and having 60-ft. booms (Fig. 1). These cranes also set the floor-beams in place.

The viaduct was built by the railway company's special force organization for track-elevation work, except that the steel erection and the cement-gun work were done by contract. It was under the direction of Robert H. Ford, Engineer of Track Elevation, who is in direct charge of the organization noted above and reports to C. A. Morsé, Chief Engineer of the Chicago, Rock Island & Pacific Ry.

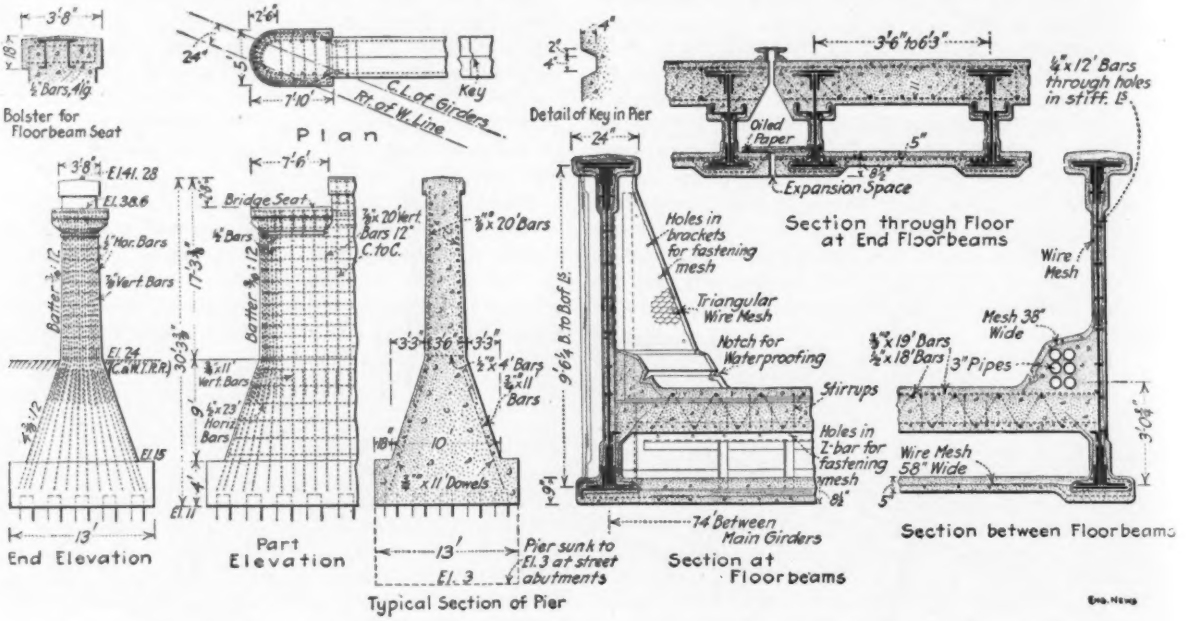

FIG. 4. CONCRETE PIERS OF 79TH ST. BRIDGE
(Note bolster for floor-beam seat)

FIG. 6. CROSS-SECTION OF STEEL SPANS
(Showing concrete casing of girders and floor-beams)

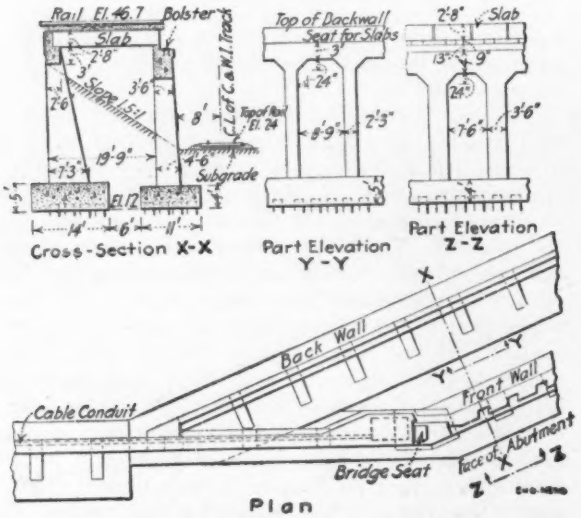

FIG. 5. DETAILS OF HOLLOW ABUTMENT
(Both walls pierced with openings and supporting a slab deck)

Making Over a Storm Sewer at Lincoln, Neb.

BY GEORGE W. BATES*

Three rainfalls at Lincoln, Neb., in May, June, and July, 1914, having intensities of 5.28, 4.80 and 7.56 in. per hr. for 5-min. periods, produced flooded conditions at a pocket in the street grades 2 ft. lower than the nearest surface outlet. The area draining toward this pocket is 178 acres, and the storm sewers previously constructed were capable of carrying off 3 in. per hr. from this territory.

An examination of the main sewer showed that it was not filled, while it was known that the 3½x6-ft. lateral from the pocket was working under a 3-ft. head (see Fig. 1). The main sewer at the junction of the main laterals was 8 ft. wide and 6.4 ft. high, with a flat bottom and a semicircular top, and a flow-line grade of 0.0053. Beyond this the sewer was considerably larger, and dropped at the rate of 0.014, giving sufficient capacity. The light-grade portion was constructed wholly of limestone, the floor being limestone slabs set on edge, apparently without mortar.

A study of the situation indicated that it would be

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safe to provide for a run-off of 1000 cu.ft. per sec., or approximately 6 in. per hr.

Further study showed that by lowering the bottom of this 8-ft. sewer a maximum of 2½ ft., sufficient capacity would be obtained, and a new 78-in. circular lateral could be built to the pocket. Owing to the uncertain nature of this work, it was decided to lower the bottom with the city forces.

The positions of the various sewers in the streets (Fig. 1) were such that the new 78-in. sewer would have to be connected to the 8-ft. sewer above the inlet of a 60-in. lateral. When this 60-in. sewer was connected to the main, it became the principal feeder, and the common wall was projected into the old sewer, thus throttling it immediately above the junction. It was found necessary to cut out the junction so as to restore the original width at this point.

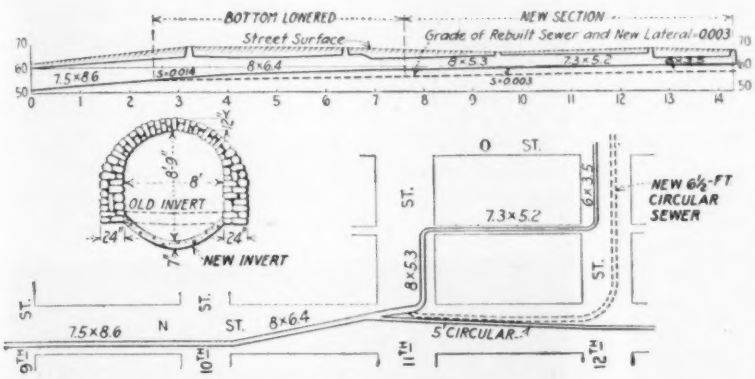

FIG. 1. MAKING OVER A PART OF A STORM SEWER, LINCOLN, NEB.

Excavation was therefore started here so as to give an extra hole for tools and materials. Wires were strung with light-sockets every 60 ft. Two 200-c.p. lights were placed in the sockets nearest the work, with smaller lights in the others. A bucket was built for the removal of the material, just small enough to pass through a 24-in. manhole ring.

The old walls extended about 12 in. below the surface of the old bottom. Excavation was carried to the base of these walls. The bottom was then rounded out in approximately semicircular shape, and a 7-in. concrete invert so placed that it rose about 6 in. on the old walls. A temporary earth dam was placed to hold the dry-weather flow. From 40 to 60 ft. of the bottom and the earth below were removed at one time, and then this portion was finished.

FIG. 2. RECONSTRUCTED SEWER BOTTOM, LINCOLN, NEB.

Work was so timed that the concreting would be completed in the evening so that it could set until morning before the water was released to flow over it, and the dam advanced. The old material was hauled in wheelbarrows on runways to the nearest manhole and raised in the bucket by means of a tripod with blocks, and a single horse for power; 1:2:4 concrete was mixed on the pavement above and shoveled through the manhole into wheel-barrows placed below. A total of 525 lin.ft. of the bottom of the old sewer was lowered in this manner. Eight feet of the top and junction wall at the 60-in. lateral was removed, and a new concrete slab top placed over the two sewers at this point. In addition, about 7000 sq.ft. of the surface of the old sewer was carefully gone over and pointed up. Some of the old limestone of the bottom of the sewer was used as plums in the new concrete base, with a considerable saving; but the larger part of the limestone was badly spalled and required so much cleaning that it was hauled to the dump.

A total of 300 cu.yd. was removed and hauled about three-quarters of a mile; 53 cu.yd. of concrete was placed in the invert, in addition to the plum stone; and 10 bbl. of cement and 6.5 yd. of sand were used in pointing up. The total cost of the work was as follows:

Wiring, lights and current	$42.51
Lumber for runways, forms and bracing	33.18
Special equipment, bucket, rubber boots, etc.	53.51
Steel reinforcing for new roof	56.32
Stone, 61 tons	121.54
Sand, 42 tons	40.34
Cement, 75½ bbl.	126.37
Labor	949.90
Total	$1423.67

The cost of pointing up the surface was $110.20, and of constructing the new roof over the junction, $90, leaving the cost of lowering the bottom $1223.47, or an average of $2.33 per ft.

The soil under the old sewer is a hard clay, with a very high bearing power. No trouble whatever was experienced or is anticipated from the removal of the lateral support on the inside of the old walls. The change of the bottom has added at least 30% to the area of the sewer, and more than that to its capacity, as the condition of the old bottom was very bad, the flow line being irregular and very rough.

A Three-Truss Single-Track Deck Bridge is an interesting structure on the Northwestern Ry., of India, and is the result of reinforcing the original two-truss bridge to carry heavier loads. This is the Bishendore Bridge on the Jhelum & Rawalpindi line. The deck spans are of the Warren truss type, on masonry piers, and the new central truss is deeper than the old trusses. To permit of placing the new truss it was necessary to remove the riveted cross-bracing and substitute a temporary bolted system of bracing, so that sections could be removed while the truss members were being placed in position, and the bracing immediately replaced and bolted. After the erection of the trusses was completed, this bolted bracing in turn gave place to a new and permanent riveted bracing, specially designed and adjusted to transfer the proper proportion of the load to the new truss. A similar method was employed several years ago in this country, for the reinforcement of the Poughkeepsie cantilever bridge across the Hudson River.

Organization and Work of a National Paving Company

SYNOPSIS—A paving organization which lays bituminous pavements in any and every section of the United States and Canada; an outline of the scheme of organization, construction and laboratory methods used by the Warren Brothers Co., of Boston, Mass., in the building of "bitulithic" pavements. How uniform results are obtained in widely scattered localities with varying materials and conditions.

The relations between the chemical and physical characteristics of bituminous cements and oils are so little understood, and the ingredients of many trade preparations are so little known, at least by the average highway engineer, that many a one has declared in despair that the only practical test was actual trial. Hence, notwithstanding any bias the highway engineer may have for or against a patented material or process, he cannot fail to be interested in the organization, laboratory and construction methods of a firm of pavement builders which has been able to obtain uniform results not merely in a restricted locality of a county or a state, but in the whole United States and Canada. Wholly aside from the relative merits of asphaltic concrete and the patented variety termed "bitulithic," the fact remains that the proprietors of the bitulithic patents have built upward of 35,000,000 sq.yd. of bituminous pavements, the great majority of which have given better service than the rank and file of bituminous pavements built by others.

Whatever the nominal monopoly in this type of construction contributes to the success of the organization, no less a part, and indeed it would seem to the casual observer, a much greater part, is contributed by the experience, skill and efficiency in making asphaltic cement and in the selection, handling, mixing and laying of the pavement ingredients—all of which are the result of many years of continuous research and experience.

Organization*

The Warren Brothers Co. has the following departments: (1) Development, (2) Financial, (3) Legal, (4) Engineering, (5) Refinery, (6) Construction, (7) Laboratory and Inspection, (8) General (Sidewalks and Roofing), (9) Publicity. All of these departments are responsible to the president of the company, and all but the first three are responsible to him through the General Manager.

Business—The duties of the Development, Financial, Legal and Publicity Departments are obvious from their titles.

Engineering—The Engineering Department designs and builds all the paving plants and purchases such equipment as the company does not itself manufacture. The Engineering Department also makes all repairs to plants and equipment with the exception of minor repairs which are made from day to day by the construction forces.

Construction—The Construction Department is in full charge of all pavements constructed by the company, constructing the same with bitulithic cement obtained from the Refinery Department and with other materials which have been tested and approved by the company's laboratory. The proportions of all ingredients used in surface mixtures laid by the Construction Department are determined by the laboratory, and formulas are given to the Construction Department men by the traveling inspectors, who are under the supervision of the laboratory chief.

Refinery—The Refinery Department has charge of the refining of all asphalt produced and used by the company and its licensees. This department also maintains a Traffic Bureau, which is continually studying freight rates, etc., to determine the best and cheapest routes for shipments.

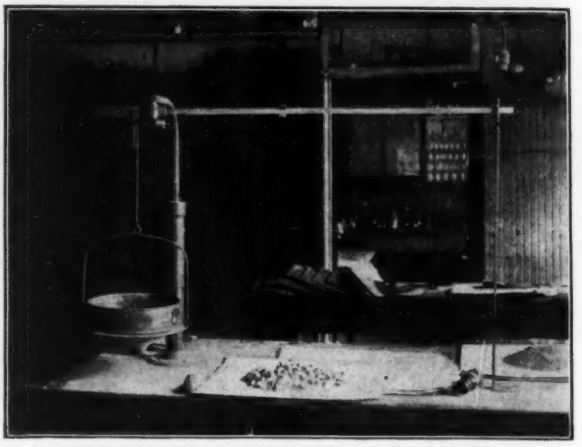

Fig. 1. Balance for Quick Weighing of Samples; Weighs 400 Grams with 1 Gram

Laboratory and Inspection—The duties of the laboratory and inspection service are to determine the character of all materials and the proportions best suited for use in the work, and to see that no other materials or proportions are used, and that the prescribed methods for carrying out the work are followed.

Research—Several expert chemists are kept at work on research problems in an endeavor to discover new methods, or improvements to the present methods. These experts are directly responsible to the president of the company and are free from all routine duties.

Field and Construction Work

As soon as development work in any district is started, field men are sent out to make studies of the climatic, traffic, financial, legal and all other conditions which can possibly affect the work, to report direct to the president. These field men obtain and forward to the laboratory samples of stone from all nearby quarries, as for reasons of economy it is naturally preferred to use local stone

*For information given under this heading and under Laboratories we are indebted to George H. Perkins, Superintendent of Refineries, of the Warren Brothers Co., Boston, Mass.

wherever obtainable; but insistence is made that only good stone suitable for the purpose be used no matter how far away it is necessary to go to secure it. At the laboratory these stone samples are tested, and the bid is based upon the use of the nearest supply which passes laboratory tests. Samples of sand are also collected from local pits and submitted to the laboratory for approval before using. Frequently sand also has to be obtained from some distance because the average bank sand consists very largely of some one-size grain and therefore does not produce the desired graded sizes of material.

The samples of stone from different quarries are tested as to wearing by abrasion and also for resistance to disintegration due to moisture.

Supervision—As soon as the supply of stone is determined upon, the laboratory makes up mixtures and ascertains the formula of proportions of the various sizes which will give the most dense mixture and advises the traveling inspector what these proportions are. This mixture for each particular job, of course, depends on the nature of the mineral aggregate and is determined from a careful study to eliminate the voids as completely as possible in the mineral aggregate.

The traveling inspector visits the city at the time work is started, inspects the street on which the pavement is to be laid, taking into account the variations of traffic conditions, grades, etc., in different parts of the street, and instructs the plant foreman and local superintendent what variations in mixture should be used to meet each of these several conditions. The inspector remains in the city until the work is well started, makes a detailed report to the general manager in Boston regarding the progress and quality of the work, condition of plant, materials, etc., with any suggestions as to changes to improve the quality or decrease cost of construction.

Control of Mixtures—The construction forces send to the laboratory daily samples of the bitumen used in the mixture and also samples of the mixture itself. These samples are analyzed immediately upon receipt, comparison is made between the analysis and the proposed ideal mixture, and a report is mailed or telegraphed to the local superintendent, as conditions may require. Copies of this report go to the general superintendent. In addition to this, the traveling inspector revisits all cities in his territory as often as possible during the progress of the work to check the quality of workmanship obtained at the plant and on the street.

The bitumen produced by the Refinery Department is carefully tested at the refinery at the time of manufacture; then samples of each lot are mailed to the laboratory for check tests before any shipment is allowed. When each shipment is received at the destination check samples are again sent to the laboratory to make sure that the material delivered is what is intended for the work.

Construction by Contractors

There are a number of corporations throughout the country who mix and lay bitulithic pavements under license. These companies have their own paving plants and are entirely separate and independent of Warren Brothers, except that when laying bituminous pavement mixtures under Warren patents they agree to use only such materials as have been approved by the Warren Brothers' laboratory, and to follow the instructions of the laboratory and traveling inspectors as to all details of their construction work. They send daily samples of bitumen and mixtures to the laboratory exactly in the same manner as is done by the Warren Brothers' own construction department.

In many cities there are also what is known as "license mixture agreements" whereby the Warren Brothers Co. agrees to install a plant in the city, produce the bitulithic mixture and sell it to any responsible contractor delivered hot in his wagons at the plant, at a stated price per square yard of pavement laid. The company also furnishes with the mixture sufficient flush-coat bitumen and flush-coat stone chips for the surface finish course.

By this method any responsible contractor who is experienced in general paving work can bid for laying bitulithic pavement without going to the expense of procuring a plant and equipment, and the technical experience necessary to manufacture bituminous mixtures properly. In such cases the traveling inspector spends several days on the street, instructing the contractor's men in the many small details which must be observed to obtain successful work.

Fig. 2. Testing Machine; Two Compartments on Left Contain Cubes for Abrasion in Air; on Right, Cube for Abrasion in Water

Laboratory

Objects of Laboratory—The objects are two-fold: (*A*) Continuous research work to ascertain the causes of defects in pavements laid by existing methods, and to discover principles and methods for producing better and more durable pavements; (*B*) to control the operations of all field forces which are laying pavements under bitulithic and Warrenite patents, to insure a uniform quality of pavement.

The research work is carried on by several experts working independently of the main laboratory at East Cambridge, Mass., aided by several operators at the main laboratory, who spend most of their time on such work.

The control of the field forces is accomplished by means of daily tests of mixtures produced at each construction plant by the laboraties at East Cambridge, Mass., and at Portland, Ore., and by the staff of traveling inspectors previously referred to. In addition to the traveling inspectors there are also resident inspectors who are stationed at cities where the construction forces of a licensee

contractor may be unfamiliar with the methods of work. The duty of resident inspectors is to see that the detailed instructions of the traveling inspectors are carried out in full.

As far as testing at the laboratory is concerned, the control is accomplished by: (*A*) Tests of all materials entering into the pavements, and approval of all supplies before their shipment; (*B*) determination of the proper proportions to be used; (*C*) check tests on samples of mixture and bitumen sent in from each plant daily, to make sure that instructions are being carried out.

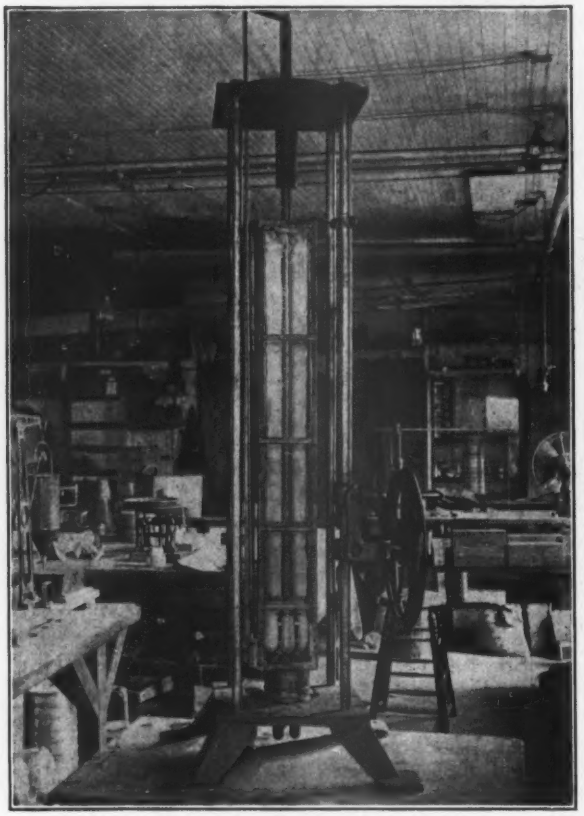

FIG. 3. DOW DUCTILITY TESTING MACHINE ARRANGED TO TEST SIX SAMPLES SIMULTANEOUSLY

STONE TESTS—Samples of stone are tested as follows: (*a*) Kind of rock; (*b*) character and texture; (*c*) shape of crushed particles (cubical, slabby, etc.); (*d*) specific gravity; (*e*) absorption; (*f*) abrasion in air; (*g*) abrasion in water; (*h*) examination of the detritus, or powder which is worn off of the sample during the abrasion test in air.

Tests (*a*), (*b*) and (*c*) are made by microscopic examination. Test (*d*) is made by the usual methods of weighing in air and water. Test (*e*) is made by submerging abraded specimens in a special oil so as to hasten results. Tests (*f*) and (*g*), abrasion in air and water, are made in special apparatus peculiar to this laboratory, invented in 1901 by August E. Schutte, who also designed many other tests and appliances especially for the Warren Brothers' laboratories.

The abrasion test as carried out by most road-material laboratories is the well-known Deval test, using a closed cylinder. With this machine, however, the detritus formed by abrasion acts as a cushion; therefore, the percentage of abrasion per revolution of the cylinder is much less toward the end of the test than at the beginning, and as the test is continued for 10,000 revolutions the variations per revolution is considerable, especially with a medium-soft stone.

To overcome this variable factor Mr. Schutte designed an abrasion machine (Fig. 2), consisting of a steel cube (8 in. inside dimension) supported upon a shaft attached to diagonally opposite corners of the cube (the shaft does not pass through). The cube has holes ⅛ in. in diameter through each corner to allow the detritus or dust to drop out into a drawer beneath, to prevent any cushioning effect. Therefore, as soon as the first rough edges are abraded off the stones, the percentage of abrasion per revolution is practically constant throughout the remainder of the test.

The Deval test is made upon stone passing a 2½ in. and retained upon a circular opening screen. The stone used in bitulithic wearing-surface mixture is seldom larger than will pass a 1½-in. screen; so it was decided to use 1000 grams of crushed stone which will pass 1½-in. circular opening hand-testing screen and be retained on a 1¼-in. similar screen.

This sample is placed in the cube and the cube is revolved 10,000 revolutions at one revolution per second. The loss in weight is expressed in percentage of the original weight and is reported as "percentage of abrasion in air." The weight of the total detritus or dust collected in the drawer is also weighed, and if some has been lost the test is repeated.

This test gives a percentage of abrasion in air from three to six times the percentage obtained by the Deval method. The softer the stone the greater the difference, on account of the greater cushioning effect of the detritus in the closed Deval cylinder.

The next step is to examine the detritus by making a screen test to determine the relative percentage passing the 8-, 10-, 20-, 30-, 40-, 50-, 80-, 100- and 200-mesh screens. For instance, if two rocks *A* and *B* show the same total percentage of abrasion, but in which the detritus of *A* is mostly 100- and 200-mesh material, while that of *B* is mostly 8-, 10-, 20-mesh, obviously *A* will be the tougher, more durable rock under abrasion of traffic than *B*.

This examination of the detritus is very important and is a factor in determining the maximum allowable abrasion for different kinds of rock; for instance, a trap rock showing about 12% of this method is almost invariably so coarse grained as to be brittle and shatter under heavy traffic. On the other hand, compact, fine-grain limestone can be used which shows 20%. It has been found necessary to work out similar maximum limits for other kinds of stone. These limits are obtained by examination of the detritus as above outlined and by watching results under actual traffic conditions.

It was found very early in the work that some rocks would pass apparently satisfactory tests for absorption and abrasion in air, yet would give trouble on heavily sprinkled streets after the flush-coat of bitumen had been worn off and the faces of the topmost stones in the mixture were exposed to traffic. In order to identify such rock before using instead of after, the abrasion test in water was devised. This test is made on a similar sam-

ple to that used in abrasion in air and in a similar cube, except that there are no holes in the corners (Fig. 3).

After placing the sample in the cube the latter is filled two-thirds full of water and the cover replaced and the cube revolved 10,000 revolutions as in the first test. Naturally, as the water retards the motion of the particles of stone, the abrasion in water should be much less than in air, unless the stone is affected by the water, which is frequently the case, and whenever the percentage of abrasion in water approximates that in air the stone is condemned.

To make sure that the sample of stone is really representative of the product of the crushing plant the

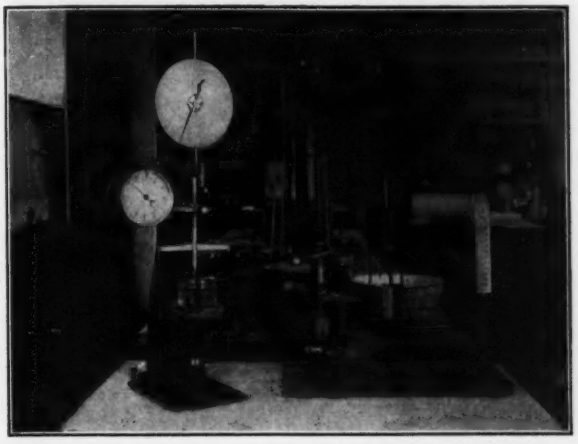

FIG. 4. DOW PENETRATION TESTING MACHINE ON LEFT; CAMBRIDGE MACHINE ON RIGHT

quarry is inspected by a competent construction man, who reports upon the uniformity of the stone in the quarry and also in case two or more qualities of stone are present, whether they can be commercially kept separate in crushing, in case one should be selected and the other rejected by the laboratory. Frequently this can be done by the use of care at the quarry, and will be done at slightly increased price; but in many quarries this is impossible, and in such cases a soft stone, even if in relatively small quantity, will prohibit the use of any of the product.

SAND—The tests on sand are of course the screen test to determine whether the bank produces the desired sizes, and examination for loam, mica, clay, etc.

BITUMEN—All bitumen is refined under supervision of the laboratory and must pass a number of special tests, in addition to the usual tests prescribed by highway engineers. The object is to secure an asphalt cement, which, due to any changes in temperature, will vary as little as possible in penetration, and at the same time will have in the highest possible degree cementing strength and waterproofness. It has been found that high cementing strength and uniformity of penetration under varying temperatures seldom occur together. It is only with great care in refining, and judicious selection, and possible combining of two or more kinds of bitumen with differing physical properties that such a combination can be secured.

Mr. Schutte developed a machine in 1903 which measures the cementing strength of the bitumen directly, and by making almost innumerable tests on all kinds of asphalts and other bituminous cements proved that of any two pure bitumens of the same consistency or hardness, the more ductile one invariably has the greater cementing strength. Therefore, as the ductility test can be made more quickly, this test is followed very closely (Fig. 3).

The testing machine devised for finding the cementing value of a bitumen breaks small beams of the paving mixture by cross-bending under a constantly increasing load. Brittleness and want of tensile or cementing strength in a burned asphalt are easily recognized.

As already noted all bitumen is tested before shipment. The practice is to ship to each paving plant two grades, one somewhat softer and the other somewhat harder than needed for the particular contract in question, so that the plant man can mix the two into approximately equal proportions and obtain the desired penetration. This has been found to work out much more satisfactorily than to attempt to ship bitumen of the exact penetration desired, as is often specified by engineers.

For instance, it is often found that in the same city the traffic conditions on different streets require bitumens of different penetrations. Again, frequently a plant will have the tanks charged, melted and reheated several times and then be prevented by showery weather from running for several days. In such cases by having two

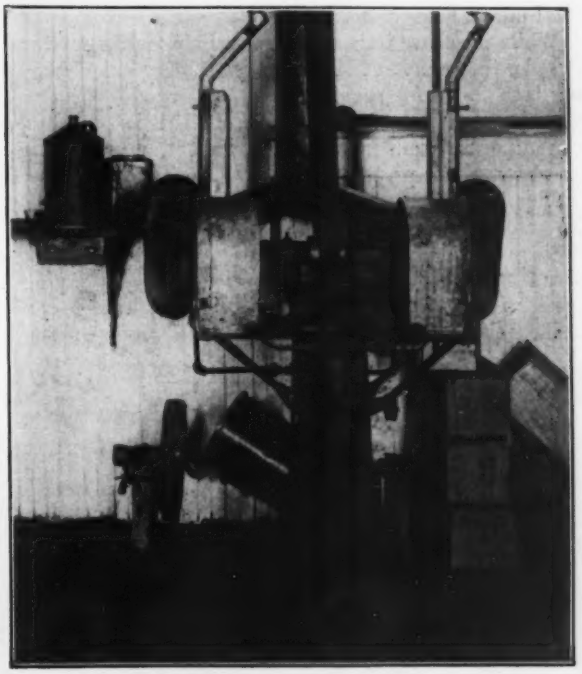

FIG. 5. CENTRIFUGAL SEPARATING MACHINE FOR MIXTURE SAMPLES

bitumens it is but a half-hour's or an hour's work to temper one tank and start up the plant, while if all the material shipped is of one penetration the plant foreman is powerless, unless he should empty his tanks and melt new material, which he is not likely to do.

In the laboratory the Dow penetration machine is used, but at the plants a stronger built machine, which has been developed at the laboratory and is known as the Cambridge penetration machine, is now used (Fig. 4).

CONTROL TESTS—In order to insure that these instruc-

tions are carried out faithfully, daily samples of the surface mixture of bitulithic cement taken from the tanks are sent to the laboratory and there analyzed and reported back to the branch, with comments as to how closely the sample approximates the ideal mixture and what should be done to correct any defects found.

It was early realized that the examination of daily samples from every plant in operation was imperative, but at that time there was no method of separating the asphalt from a coarse aggregate. Mr. Schutte designed several machines for this purpose, finally designing a centrifugal machine, Fig. 5, which extracts all the bitumen from a 1000-gram sample of mixture in a little less than 15 minutes, so that with a battery of four of these testing machines in use at the Cambridge laboratory, 150 samples can be handled daily.

HANDLING MIXTURE SAMPLES—As soon as the sample reaches the laboratory it is registered, warmed in an oven, passed through the extraction machine to determine the percentage of bitumen, and the remaining mineral aggregate is placed in a nest of 15 screens varying in size from 1½-in. circular opening to No. 200 mesh.

This nest of screens is placed in a mechanical shaker for 15 minutes, which is sufficient to separate the different sized particles accurately, when the aggregate passing each screen is weighed to 1 gram, which is 0.1% of the total mineral aggregate.

While the above tests are being made upon the mixture sample, the sample of bitulithic cement accompanying it has been tested for penetration and the results of all the above tests are collected, and a typewritten report, showing in parallel columns the ideal mixture and the analysis of sample, is prepared.

This then receives the comments of the director of the laboratory and is mailed the same evening. Of course if there is anything seriously wrong, a telegram is sent ahead of the report, and if advisable the traveling inspector for that district is instructed by wire to proceed to the work immediately, and is given discretion to order removal of all unsatisfactory mixture. The idea is that it is cheaper to correct an error immediately, while the plant is in operation, than to wait until defects develop in the pavement and then probably have to send a plant in from some distance.

Some Recent Developments in Concrete Mixers

The increasing amount and variety of concrete construction work result naturally in numerous improvements and modifications in machines for mixing and placing concrete. The following description relates to recent developments in the machines built by the T. L. Smith Co., of Milwaukee, Wis.

LARGE CONCRETE MIXERS FOR PAVING WORK

The concrete-mixing outfit for street paving and highway work which is shown in Fig. 1 represents the latest developments and includes some special features adapted to certain conditions of work. The mixer is of the non-tilting drum type, and the drum has its interior blades made deeper and of a steeper angle than before, so as to do the mixing more efficiently and to discharge the concrete more rapidly and completely.

The drum has a capacity of 14 cu.ft. of mixed concrete or 20 cu.ft. of loose material, and the machine can place 1400 to 2200 sq.yd. of 6-in. thick concrete per 10-hour day. It is equipped with a 12-hp. steam engine and 14-hp. boiler, a 30-gal. water tank, a loading skip 8 ft. wide and a rotating distribution pipe 15 ft. long. A 12-hp. gasoline engine would be used on such a machine. The next size of machine has a drum of 9 cu.ft. of concrete (13½ ft. loose material) and can lay 900 to 1200 sq.yd. of 6-in. concrete per day. This has an 8-hp. steam engine or 9-hp. gasoline engine.

The machines are selfpropelling, with a speed of 1 m.p.h. in either direction. The front end is carried ordinarily by large wide-tired traction wheels, with a sprocket

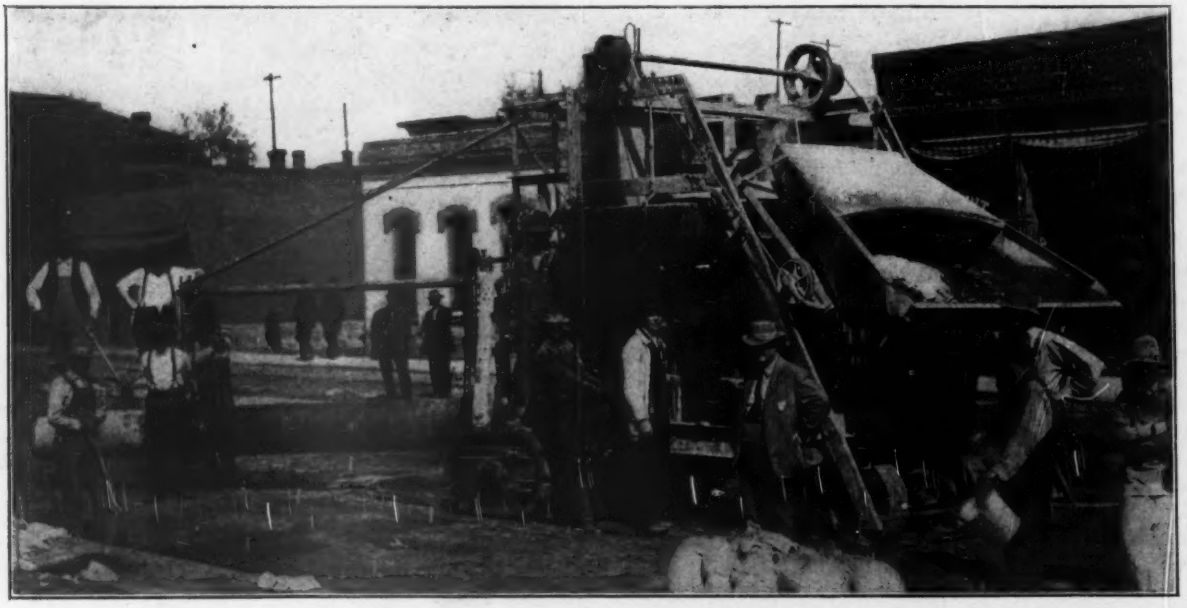

FIG. 1. LARGE CONCRETE MIXER FOR PAVING WORK
(Equipped with caterpillar traction and rotary distributing pipe)

driving chain to each wheel to equalize the strain. The steering is done by swiveling these wheels on the ends of a fixed shaft, as in automobile practice, the shaft having vertical play to allow for irregularities in road surface. In the machine shown in Fig. 1, intended for use on a soft subgrade, the forward end is carried by a pair of caterpillars instead of by the usual traction wheels.

The cable-operated charging skip is swung to an almost vertical position when raised, so as to insure a complete

FIG. 2. LIGHT PORTABLE CONCRETE MIXER

discharge of the contents into the drum. A trip releases the clutch automatically when the skip reaches the end of its travel, thus avoiding overwinding and consequent strain on the machinery. The skip lies flat on the ground when lowered and is of such width (8 ft. or 6 ft.) that three (or two) wheelbarrows can be dumped into it simultaneously. This expedites the work by reducing the time required to load.

The concrete is delivered into place usually by an inclined open chute, the upper end of which is beneath the discharge chute of the drum. Its length is 12 ft., and it can be swung through an angle of about 180°, so as to cover a strip of paving 20 to 24 ft. wide. The chute is made with hinged sections, so that the concrete can be delivered at four points within its length, thus depositing it inside of the arc described by the extreme end of the chute. In this way a strip of paving 12 ft. long can be laid without moving the machine.

ROTARY DISTRIBUTOR

Where the width to be concreted is over 25 or 30 ft., the larger machines may be equipped with a revolving pipe chute or rotary distributor, which is shown in Fig. 1.

This pipe is 15 ft. or 18 ft. long and is suspended from a swinging boom. Its outer end revolves in a ring-bearing attached to a bail hung from the boom by a pair of rods. Its inner end is fitted with a sprocket wheel for the driving chain, this chain being vertical and passing over a smaller wheel on the boom. At both points of support the pipe revolves in a sliding dust-proof bearing. The mixer drum discharges the concrete through a chute into the revolving pipe, the interior of which is fitted with blades which feed the concrete forward and serve also to keep it well mixed during its travel.

The pipe chute, however, will deliver concrete only at its end, and not at intermediate points, as does the inclined chute. Consequently the machine must be moved more frequently. Thus for a mile of paving the machine with rotary distributor must make 2640 moves of 2 ft. each, while the machine with inclined chute would make 440 moves of 12 ft. each. The crew can work to better advantage with the latter arrangement. On the other hand, if the paving is too wide for the reach of the inclined chute the machine has to do the work either in two strips or by traveling a zigzag path from side to side. This is not satisfactory, and the rotary distributor then has the advantage.

SMALL PORTABLE MIXER

The "Mixerette," shown in Fig. 2, is a light and portable machine of small capacity, suitable for various classes of work. It has a nontilting drum with a capacity of 3 cu.ft. of concrete and can produce about 5 cu.yd. per hour. The drum is supported by a circular casing which has two machined tracks to engage the circular tracks on the drum, no supporting rollers being used. This casing in-

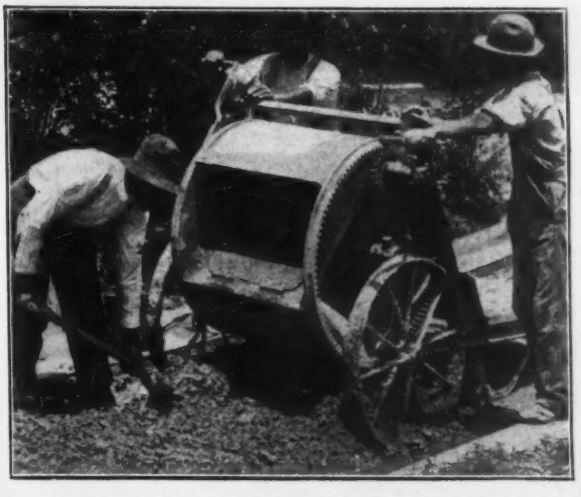

FIG. 3. HAND-OPERATED CONCRETE MIXER

closes the drum ring, which combines the circular gear and tracks.

The loading skip is operated by a pinion and quadrant gear (shown beneath the skip in Fig. 2). It is controlled by a jaw clutch and brake, but when it reaches the discharge position the clutch is released automatically, so that there is no strain on the machinery if the operator should be slow in releasing it. The machine is operated by a 2-hp. gasoline engine inclosed in a steel housing. Its total weight is about 2500 lb. This is reduced to 1875 lb. if the power-operated skip is replaced by a fixed hopper for loading from wheelbarrows.

HAND MIXER

The adaptation of machine mixing to the small pieces of work for which hand mixing is commonly used is one of the more recent developments in concreting machin-

ery. Such work includes not only small jobs, but larger jobs where concrete is used in a number of small separate units. The hand-operated concrete mixer shown in Fig. 3 makes a batch of 2½ cu.ft.

The drum is 36 in. diameter and 32 in. long, with an internal gear on each end, engaging with pinions driven by the crank handles. The entire machine weighs only about 1000 lb. and can be moved easily. It is stated that five men with this mixer can make and place 25 to 30 cu.yd. of concrete in a working day. The cut shows the machine at work on a private driveway at Atlanta, Ga. An interesting example of its use was in making the footings for the posts of snowsheds on the Great Northern Ry., as described in ENGINEERING NEWS of June 4 and Aug. 6, 1914.

Bale Conveyor in a Cotton Warehouse at Galveston, Tex.

By JOHN R. FORDYCE*

The concentration of cotton at the port of Galveston, Tex., has necessitated the building of large storage warehouses and compresses, of which the plant of the Galveston Cotton Compress & Warehouse Co., completed last year, is one of the notable examples. The buildings are of reinforced concrete; the warehouses are of the high type, in which it is intended to pile up the bales.

This plant is intended to handle the cotton consigned to the firm of W. S. Moody & Co., which does an exclusive factorage business. That is, the owner of the cotton ships it to them for storage until such time as a sale is made. This business and the way it is handled here influenced the design and arrangement of the buildings. When completed, the plant will occupy seven square blocks of ground (with the included streets), or an area of about 1150x712 ft., exclusive of the ground covered by railway track.

Cotton bales are brought in freight cars to tracks adjoining the plant, whence they have to be transported successively to unloading sheds, warehouses, classing sheds, compresses and outbound sheds. The great area covered and the distance over which bales have to be carried necessitated some better and more economical method of transportation than the hand truck carrying one bale of 500 lb. each. To meet this need, the writer designed and there has been installed an overhead bar track on which two-wheeled trolleys, with hooks to carry the cotton bales, run from the railway track to all parts of the plant. This track is level over most of the way and a man can give a bale a push which will carry it 250 ft., or one man can easily push 10 bales in a string. It is supported in a channel-iron and both are suspended by brackets and rods from the concrete structure of the buildings, the proper reinforcing rods and inserts being placed in the concrete when it was cast.

The method of handling the cotton is as follows: The bales are received from railway cars in the unloading shed. They are lined out, weighed and sampled, and then hung on the trolley (Fig. 1); they are then pushed along to the track leading into the alley communicating with the warehouse, where they are piled up in storage.

These storage warehouses face the alley and the bales suspended by the conveyor (Fig. 2) are carried to the warehouse door, whence they are trucked to their proper location. When the bales are sold, the warehouse men get them out, carry them by conveyor to the classing shed, where they are examined and compared with the samples. The overhead conveyor in this shed is shown in Fig. 3. Owing to the congested condition of the plant this year, the classing shed is being used mainly for storage, hence the piled-up bales which the photograph

*Engineer, Little Rock, Ark.

FIG. 1. COTTON BALES FROM FREIGHT CARS ON RIGHT LOADED ON CONVEYOR

FIG. 2. TAKING BALES FROM CONVEYOR TO WAREHOUSE
(Incoming bales arrive on freight cars shown at far end of alley)

shows. Ordinarily, the bales would be arranged in rows. This shed has a sawtooth roof, so that bales can be examined in a uniform northern light.

When ready for compressing, the bales are taken on the conveyor to the press room, where the bands are cut and the bulk reduced about two-thirds. After compressing, the bales are either taken at once to the wharf by electric trucks carrying 25 bales (about seven tons), or they are stored temporarily in the outbound shed, awaiting a ship. Fig. 4 shows an electric truck loaded with uncompressed bales.

This simple level-track conveyor system on which bales can be pushed either way is proving a great success and a labor saver, and it is due to the hearty coöperation of J. E. Mitchell, the manager of the plant, that it has been made practical. His simple devices for loading and unloading the bales, his crew of trained men to operate it, and his personal supervision, all have been potent factors in bringing it up to its present state of efficiency.

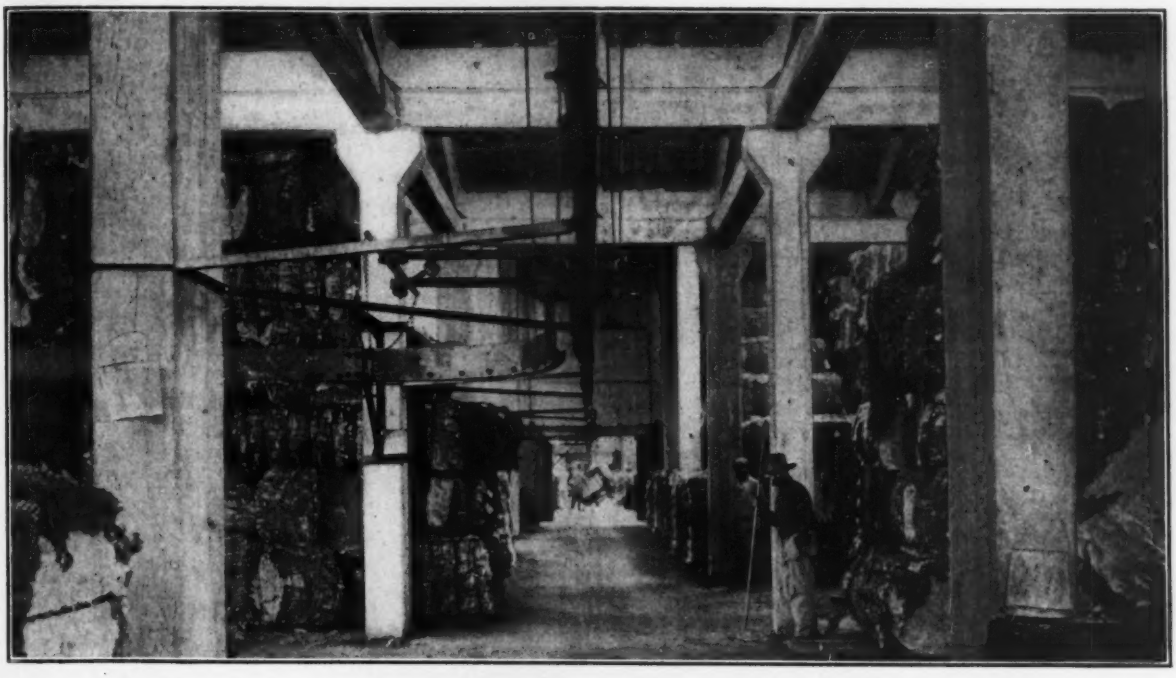

FIG. 3. INTERIOR OF CLASSING SHED, WITH CONVEYOR ENTERING FROM SIDE BAY

All of the buildings of the plant were built according to the unit precast system by the Unit Construction Co., of St. Louis. The trolley system was built by the Southwestern Mechanical Co., of Ft. Worth, Tex.

The new plant of the Merchants & Planters' Compress & Warehouse Co., now being constructed alongside of this plant, will be equipped with a similar system of cotton conveyors.

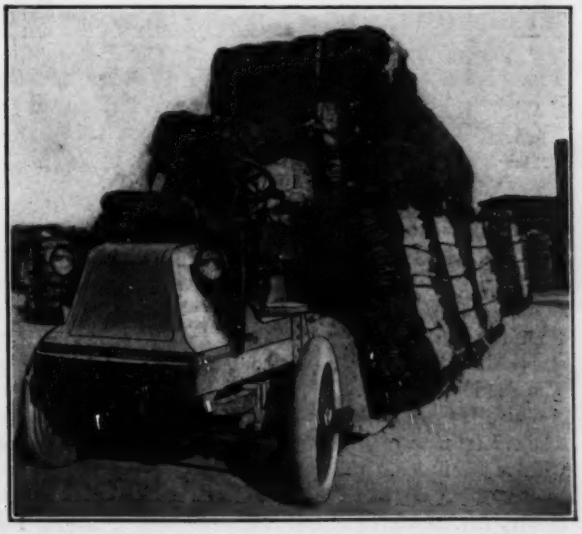

FIG. 4. ELECTRIC MOTOR TRUCK WITH 20 COTTON BALES, GALVESTON, TEX.

Road Work in West Virginia—Eight counties in West Virginia are planning, or have issued, bonds to the extent of over $2,000,000 for road work during the coming season. Besides this we are informed about $2,000,000 more will be available for highway improvement, and $600,000 will be spent on highway bridges in 1915.

Buildings in Greater New York—There is a total of 375,037 buildings in New York City, according to the New York "Times," apportioned as follows: Manhattan, 84,849; Bronx, 35,163; Brooklyn, 172,380; Queens, 62,525; and Richmond, 20,120. Brooklyn has more one- and two-family dwellings than any of the other boroughs: 62,080 and 49,505, respectively, and the most tenements without elevators, 45,956. Manhattan has 2155 elevator apartment houses and hotels, as compared with 70 for the Bronx, 209 for Brooklyn, 231 for Queens, and 82 for Richmond. Manhattan has 813 office buildings, as against 69 for the Bronx, 145 for Brooklyn, 95 for Queens, and 47 for Richmond. Brooklyn leads in factories, with 2364, whereas Manhattan has 1428, Bronx 250, Queens 621, and Richmond 627. Manhattan has 7964 warehouses, loft buildings, and department stores, as compared to 1551 for Brooklyn, Bronx 142, Queens 40, and Richmond 85. There are 229 theaters, not including moving picture theaters, in all the boroughs, of which Manhattan leads with 128, Brooklyn 68, Bronx 12, Queens 18, and Richmond 3.

Storm Damage to Sea Walls on California Coast

During the last two winters the storm damage to property along the coasts of the United States has been very great, particularly in those towns and cities where some misguided or weak attempt has been made to protect the shore against occasional severe wave action. We have shown a number of views of the destruction wrought

FIG. 1. TYPICAL SECTION OF FIRST BEACH WALK AT LONGBEACH, CALIF.
(This is not drawn to scale)

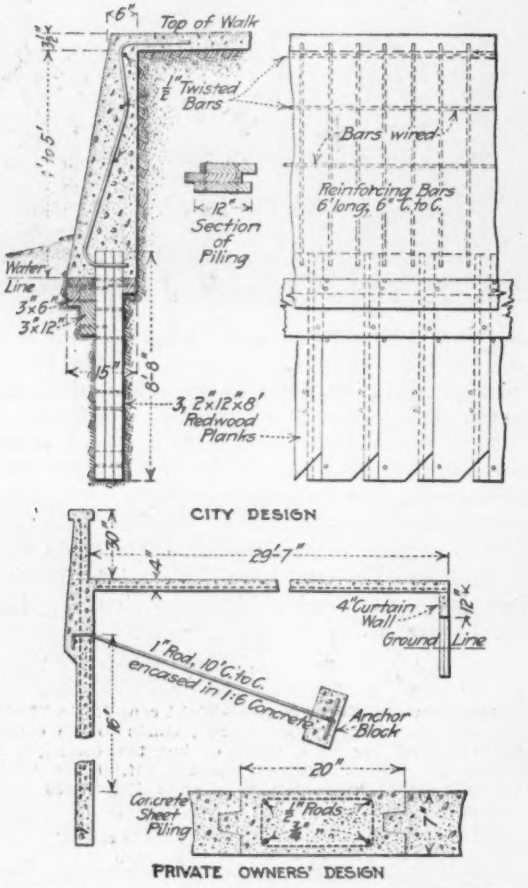

FIG. 2. SECTIONS OF RECENT SEA WALLS AT LONGBEACH, CALIF.
(The upper drawing shows the construction employed by the city. The lower drawing shows the construction employed by private owners)

along the summer resort section of the New Jersey coast, where the estimated cost of the necessary protection has become so great that federal aid is being solicited. The accompanying views of recent conditions at Longbeach and Redondo in California show that the problems of the Pacific are as serious as those of the Atlantic.

The city of Longbeach, Calif., 20 miles south of Los Angeles, has six miles of beach with a slope of about 2%. The fine sand is over a layer of clay and varies from 8 ft. in depth in the eastern portion of the city to 20 ft. in the western portion. The range of tide is 9 ft. and the ocean is usually very calm, but occasionally a high tide combined with a storm such as occurred in December, 1914, causes large breakers which cut out the sand for a depth of about 5 ft. along the ocean front, with consequent damage to structures on the beach.

As property along the beach became valuable, piles 8 to 10 ft. apart were driven along the line of ordinary high tide and horizontal lagging was spiked to these, forming wooden bulkheads 5 ft. high. Sand was filled in behind them, and houses were built on the land thus re-

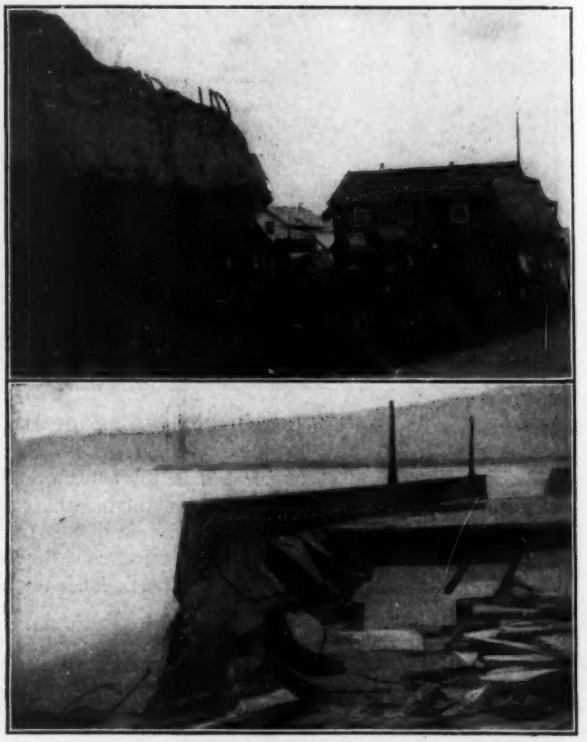

FIG. 3. FRONT AND REAR VIEWS OF THE DESTRUCTION OF SEA WALL AND BEACH WALK AT LONGBEACH, CALIF., IN THE STORM OF DECEMBER, 1914
(This work was of the construction shown by the lower drawing in Fig. 2)

claimed. The bulkheads were satisfactory until the piles rotted off above the water line in the sand.

The next attempt at protection was to dig a trench in the sand and then (without any foundation other than the wet sand) to build a concrete wall, about as shown in Fig. 1, reaching about 5 ft. above high tide. The sand was filled in behind this wall and a 35-ft. concrete walk 2700 ft. long was built in connection with it. The official plan for this wall shows that it was reinforced with vertical pieces of barbed wire 30 in. apart. The wall was constructed about eight years ago and was satisfactory till the storm of last December, which carried out the sand to a depth of about 4 ft. in one night and undermined the wall for a distance of 1300 ft., so that it fell

over into the waves and was broken to pieces. About half of the width of the 35-ft. walk was destroyed, but prompt work with bags of sand saved the half farthest from the wall for the entire length. The predicted high tide for the night of the storm was 7.4 ft. The elevation of the walk is 4 ft. above this, but solid sheets of water were washed over it. In two weeks after the storm the sand was washed back and by the middle of January it was 3 ft. below the level of the walk.

The plan adopted for the reconstruction of the wall is to drive a line of Wakefield triple-lap sheet piling into the underlying clay, and to build upon this a reinforced-concrete wall. Clay is used for backfilling, to avoid the trouble due to the escape of sand filling. The piles are of 2x12-in. redwood planks, 8 ft. long. As these will be always in wet sand they should last for many years, while it is expected that the wall will be of ample strength to withstand the storms. This construction is shown at the top of Fig. 2. It was designed by Ben F. Dupuy, City Engineer, and a portion of it has been built.

At the western portion of the city an attempt is being made by property owners to build a sea wall 100 to 200 ft. nearer the water than the city's sea wall described above. This appears to have proved a failure. The contract was awarded in March, 1912, for a sea wall and 30-ft. concrete walk in combination, 7120 ft. long, for $73,000. The first 2000-ft. section was completed and 75% payment made on it. The next 2000 ft. was finished also, but no payment was made on this, as the sand was running out between the piles and the walk in many places was not supported. The construction is shown by the lower drawing in Fig. 2; effects of the storm upon it are shown strikingly in Fig. 3.

We are informed that the sand has run out between or under the piles for the entire length of the work and that all of the second 2000 ft. of walk has fallen down and been broken, while for several hundred feet the wall has been broken off at the top of the piling. Where the walk has not fallen it is supported on wooden posts. The city engineer's office has never approved the plan for this work, which, as stated above, is entirely under private control.

FIGS. 4-6. VIEWS SHOWING PROGRESS OF DAMAGE TO OCEAN FRONT AT REDONDO, CALIF.

The views in Figs. 4-6 show the progressive action of a storm during about ten days in February, 1915, at the beach front of Redondo, Calif. Fig. 4, taken Feb. 2, shows the approach of the high water to the flimsy board bulkhead protecting the marginal street and the nearby houses. Fig. 5, taken Feb. 7, shows the first damage done by the storm and the high water just receding. Fig. 6, taken Feb. 13, is a view of the same territory (the individual houses may be easily identified in the three views) after the storm's force was abated and the ocean was back to its normal height.

Engineering Literature

REVIEWS AND NOTES

The Chemistry of Hydraulic Cements

REVIEWED BY P. H. BATES*

DIE CHEMIE DER HYDRAULISCHEN BINDEMITTEL: Wesen und Herstellung der Hydraulischen Bindemittel—Von Dr. Hans Kühl, Inhaber, und Dr. Walter Knothe, 1. Assistent, des Zement- und Mörteltechnischen Laboratoriums Dr. Wilhelm Michaëlis, Berlin-Lichterfelde. Leipzig: S. Hirzel. Paper; 7x10; pp. xvi + 347; 51 illustrations. 14 Marks.

The successors of the late Dr. Michaëlis have compiled some most interesting theories and facts dealing with the chemistry of hydraulic cements.

The book aims, first, to present certain fundamental principles of chemistry and physics which are of vital importance in investigating "heterogeneous systems," such as the raw mix of portland cement, in order that the less informed reader may more readily interpret and properly value the results of many investigations given later. It is to be regretted, however, that the authors presented these principles so briefly, since it is impossible for anyone not already more than passingly acquainted with them to realize completely their purport and meaning. Consequently, the book will not appeal strongly to many cement and concrete engineers and chemists.

All hydraulic cements are placed in one of two classes—(A) latent hydraulic cements and (B) hydraulic cements. The significance of this classification is more readily understood by the further subdivision of (A) into (1) manufactured latent hydraulic cements and (2) naturally occurring latent hydraulic cements, embracing under (1) slags to which either portland cement clinker or lime have been added to develop their latent hydraulic properties and under (2) trass and puzzolana to which either clinker or lime have again been added for the same reason. (B) is subdivided into (1) nonsintered cements and (2) sintered cements—the former embracing hydraulic limes and Roman cements and the latter portland cement and certain slags. This classification is excellent and constitutes one of the few original ideas of the authors.

While all hydraulic cements are included within the scope of the work, yet almost two-thirds is devoted to portland cement. As there has been but little advance in recent times in the knowledge of the other cements, and as their commercial importance is constantly decreasing, the authors are justified in giving relatively small space to this part of their subject.

An idea of the treatment of the subject-matter under portland cement may be gained from the titles of the various chapters: "The Physico-Chemical Principles of Mineral Investigation"; "The Ternary System—Lime, Silica, Alumina"; "The Constitution of Portland Cement"; "The Raw Materials"; "The Chemistry of the Burning Process"; "The Thermo-Chemistry of the Burning Process," and finally one chapter of but 20 pages dealing with the grinding and preparation of the cement for the market, its properties and testing—a chapter which usually affords enough for a volume.

It can be seen from these chapter titles that the volume is distinctly theoretical in its nature. It would fill a long-felt want if the theories and the results of the investigations reported were not so distinctly European and if they had done a little more than just mention the remarkable results of the Geophysical Laboratory in this country. The chapter devoted to the discussion "Physico-Chemical Principles" cannot in any possible manner be compared with the latest publication of this latter laboratory on the lime-silica-alumina system in the January, 1915, number of the *American Journal of Science*. The authors have attempted to present too many principles, and all of them in too small a space.

The same thought applies to the other chapters. The facts presented are the latest results of European, and especially German, investigators. There are included the results of Janecke, Glasenapp, Wetzel and others, which were presented at the 1914 meeting of the German Portland Cement Manufacturers' Association. There are consequently given the latest ideas in regard to alit, belit, celit, etc., as well as the original ideas of Tornebohm. It might be of interest to mention that the authors state alit is "a solid solution of a highly basic silicate and a highly basic aluminate of lime, accompanied by dissolved lime; alit is at all events never entirely without alumina."

The chapter devoted to the chemistry and thermo-chemistry of the burning process consists mainly of a discussion dealing with a comparison of the extent and character of the reaction which takes place in the shaft, ring and rotary kilns; a comparison of the clinker produced in each of these kilns, and a calculation of their theoretical efficiency. Some space is also devoted to a discussion of the relative efficiency of the rotary kiln when used on wet and dry raw mixes. These two chapters are of much interest and should be of considerable value to manufacturers in this country, since the wet process of burning is beginning to find a little more favor here. Consequently, discussions of its efficiency are welcome, especially from the German standpoint, since this process is used more generally there than here. Of interest also is the statement by the authors that the average burning temperature of cement is about 1425° C. (2597° F.).

The chapter devoted to the preparation of the cement from the clinker and its testing may seem brief, but it is, on the other hand, of about the proper length for a work on the chemistry of cement. The matter is concisely stated and no unnecessary attempts are made to correlate the composition and physical properties.

On the whole, the work is satisfactory—especially so as a compilation of all European investigations. These are presented in a very concise manner, without entering too much into a discussion of relative values. In view of the present conflicting theories as to the constitution of cement this was the proper method of handling the sub-

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ject. The lack of inclusion and proper interpretation of the very many valuable results of the Geophysical Laboratory reduces its value here decidedly. It should serve as a desirable model for a similar work, which would include the theories of all countries, to which also should be added a little more of the practical side of cement manufacture, testing and using.

Railroad Problems

RAILROADS: FINANCE AND ORGANIZATION—By William Z. Ripley, Nathaniel Ropes Professor of Economics, Harvard University. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. xix + 638; 29 maps and diagrams. $3, net.

One of the crowd of "tin-plate millionaires" who injected the water into the Rock Island Ry.'s finances a dozen years ago had the effrontery to say, in his recent examination before the Interstate Commerce Commission, that nobody was injured by the issue of the flood of Rock Island securities—or insecurities. If anyone believes this statement, they should read Prof. Ripley's volume before us, in which he makes clear to the reader just how that famous "Rock Island crowd" operated in transferring money from the pocket of the innocent investor to their own.

It is not a pleasant story that Prof. Ripley has to tell, but it is a story the main facts of which, at least, ought to be known to intelligent citizens, and particularly to engineers, who, in connection with their responsibility for railway construction and operation and the great work of valuation now in progress, should know the inside of railway financial methods.

The opening chapter of the book is devoted to the methods that have usually been employed in financing railway construction. The following three chapters deal with railway capitalization, the issue of different classes of securities, etc. Then come chapters on the course of market prices for capital and for railway securities, on the effect of speculation, on stock watering and state control over the issue of securities. Chapter 10, on the determination of reasonable rates, concludes with a demonstration that the physical valuation of the railways, with which the following chapter deals, was urged by the attorneys for the railways in notable rate cases. The concluding half dozen chapters deal with the relations of the railways to each other, the progress of combination and consolidation, and pooling agreements.

It is not to be denied that as one reads Prof. Ripley's book he cannot but feel overwhelming disgust with the whole machinery by which the eminent financiers on the inside who have manipulated our great railroad properties have rolled up enormous fortunes through methods as dishonest as those of the burglar or footpad. We cannot comfort ourselves, either, by saying that these things pertained only to men of a past generation and to railways of the wild-cat order, for some of the shady operations described in Prof. Ripley's book date back only two or three years; and it needs only a perusal of the financial columns of the daily journals to find hints concerning the fights in progress between the financial vultures who are picking the bones of defunct railway properties.

Many men doubt whether there is any way out of this confusion other than the radical change to government ownership and operation, with all the difficulties and dangers and waste which everyone who has carefully studied the problem knows must be met. It is of interest to see what the opinion of Prof. Ripley himself is on this point. In his preface he says:

> The present is indeed a critical time for the advocates of private property in railroads under public regulation. More than a generation and a half ago the people of the United States set about the great task of subjecting their common carriers to public control. After a stubborn contest the battle has been won. The railroads have surrendered and seem to have accepted public control in good faith. They are at the mercy of the public which has assumed the grave responsibility for a wise exercise of its authority.

Prof. Ripley believes that, notwithstanding the crimes in high finance which he has exposed in this book, "never in our history, and probably nowhere else in the world, has the standard of probity and the quickened sense of responsibility, both public and private, among American railroad men been more pronounced than it is at the present time."

His two principal constructive suggestions are, first, that the states should relinquish control of railway financial operations to the Federal government, and, second, that "some affirmative action should be taken to permit and even to encourage such coöperation among railways as shall tend to eliminate the economic wastes of competition without losing its manifest advantages to the public."

The present volume forms a companion and continuation of the author's earlier work on railroad rates and regulation, which was reviewed in these columns two years ago. The two books are a contribution of great public value to economic and financial history.

CIVIL ENGINEERING TYPES AND DEVICES: A Classified and Illustrated Index of Plant, Constructions, Machines, Materials, Means and Methods Adopted and in Use in Civil Engineering Works of Every Class, for the Use of Engineers, Draftsmen, Students, Builders and Contractors —By T. W. Barber, M. Inst. C. E., author of "The Engineer's Sketch-Book of Mechanical Movements," etc., "The Repair and Maintenance of Machinery," "The Port of London and the Thames Barrage," etc. New York: D. Appleton & Co. London: Crosby Lockwood & Son. Cloth; 6x9 in.; pp. viii + 245; 1760 illustrations. $3.

The author of this book, an English engineer, says in his preface that it is intended as "a collection of all the known devices and methods in use in every branch of civil-engineering work." This end is attained, in the encyclopedic manner, by graphic representation of the simplest kind accompanied by brief definitions. There are many outline drawings of familiar and unfamiliar devices, structures and tools which may give a hint to some busy engineer who is groping to express in design an elusive idea.

THE SALEM FIRE—By Arthur B. Jones, Ex-Assistant Fire-Chief of Salem, Mass. Boston: The Gorham Press. Cloth; 5x8 in.; pp. 137; illustrated. $1.

So many articles have been written on the whys and wherefores of the Salem fire that a book bearing that title is not surprising; but that this book should be written by a fireman who participated in the activities of June 25 is interesting. The book endeavors to supply accurate information regarding the various calls and orders given, the behavior of the local fire department and that of the visiting firemen, and the measures taken immediately subsequent to the burning. Firemen generally, and especially those who served at the Salem fire, will probably like the book.

The United States Coast and Geodetic Survey has issued an interesting booklet (Special Publication No. 23) for free distribution at the Panama-Pacific Exposition and also by the Superintendent of Documents,

Washington, D. C. It gives a brief history of the Survey, which is one of the oldest engineering bureaus of the general government, and describes geodetic and hydrographic surveys in popular language. The booklet contains much that all engineers should know regarding what the Survey is doing and how it may help their own practice.

A Translation of Giolitti

REVIEWED BY WILLIAM CAMPBELL*

THE CEMENTATION OF IRON AND STEEL—By Dr. Frederico Giolitti, Professor in the Royal Polytechnic of Turin. Translated from the Italian by Joseph W. Richards, Professor of Metallurgy at Lehigh University, and Charles A. Rouiller, Assistant in Chemistry at Johns Hopkins University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xv + 407; 155 illustrations. $4, net.

Half of this book is devoted to the chemistry of the cementation process and half to its industrial applications.

As an introduction, the author gives us a concise and clear history of cementation. He mentions Biringuccio's ("Pirotechnia," 1540) and Agricola's ("De Re Metallica," 1556) descriptions of the heating of billets of soft iron in molten cast iron, which yields up carbon to the soft iron like a liquid cement. While history records no certainty that steel was made by cementing iron in a carburizing powder, in the Middle Ages, it discloses a probability that the armorers knew this method but kept it a trade secret. In the sixteenth century true case-hardening was practiced, but it was only in the seventeenth that the manufacture of cement steel in the form of bars to be forged developed to any extent. It flourished in Piedmont and in England and soon spread to Belgium and Germany, but was guarded jealously as a secret art.

The first researches of a scientific nature are outlined—those of Réaumur, whose memoirs to the Academy of Sciences of Paris, 1720 to 1722, gave to the world rules for the technical application of the process of cementation (and also of malleabilizing). The author shows the impetus which these investigations gave to the industry, so that within a few years factories sprang up in Sweden, Germany and England. The superiority of English steel is attributed to the superlative quality of the iron imported from Sweden. Further on is noted Huntsman's discovery of the crucible process, in 1740, which gave a further impetus to the industry; while the introduction of puddled steel and the Bessemer process caused a decline of cementation. The conclusions of Caron (1860-64), Frémy (1861) and Margueritte (1864) are considered. The work of Mannesmann is carefully discussed as the last of the early investigations on cementation.

The second period of research described was one in which but few new experimental data of real importance were brought to light in regard to opposing hypotheses of cementation. The different ideas are given in detail, some of which, in view of our present knowledge, appear to be more or less amusing. With these are the more recent studies, beginning with the work of Charpy and of Guillet, taking up the question of rate of cementation, especially in regard to the role of gases in cementation, and again of the efficiency of different cementation materials, and of the effect of cementation on nickel, manganese, chromium, tungsten and silicon steels.

The author next takes up the researches of himself and collaborators—Carnivali, Tavanti, Astorri and others—in regard to the cementation of iron and steel. The author develops his subject logically and clearly, not only from his own experiments but from the previous work of others, until he shows us that cementation and its anomalous variations are due to the different states of equilibrium of the systems ($Fe.Fe_3C.\ CO.\ CO_2$) and ($C.CO.\ CO_2$).

In the second part, dealing with the practical application of the subject, the author points out that the question of total cementation and the production of blister steel is of comparative unimportance, but that the question of case-hardening is one of growing interest. He discusses, first of all, the typical furnaces used for case-hardening with solid fuels. He then takes up the question of the different cements and seems to conclude that the mixture advocated by Caron, namely, pure wood charcoal, 60 parts, barium carbonate, 40, is about the best. In addition, this mixture has the advantage that it "regenerates" easily and spontaneously on exposure to air. The author points out that the weird and fantastic mixtures used by some works and patented by some people give no better results than the simpler materials.

Of great interest is the section on cementation with gaseous cements, which is apparently just in its infancy. The Marchlet furnace is described and then an example of the two-muffle furnace is given, illustrated by a patented furnace (Ansaldo) of "Ch. M. Stein," of Paris. Of even greater interest to the practitioner is the chapter on the correct thermal treatment of cemented products, especially in regard to their resistance under shock. This covers not only ordinary carbon steel, but also results on alloy steels as well.

Both the student and the practical man of affairs will find this book a source of valuable information. The main criticism that can be made of it relates to the method of presentation. For example, in the first part, the reader is led through the different researches and the different ideas and theories as to the active cause of case-hardening, being given first one set and then another. The consequence is that before he reaches the end of the chapter his ideas have become quite hazy. It would seem that the better plan would have been to show at the beginning what was the correct theory of cementation and then to show the developments which led to these ideas. Because of the method of presentation followed, perhaps the general practitioner will find some difficulty in wading through the first part of the book.

FIELD SANITATION; A Manual for Noncommissioned Officers—By James Sprigg Wilson, Major, Medical Corps, United States Army. Fourth edition. Menasha, Wis.: George Banta Publishing Co. Linen; 4x6 in.; pp. 123; illustrated.

The present edition of this little book contains a few words on camp diseases, followed by notes on personal hygiene and clothing, water and its purification, subsistence, wastes and their disposal, first aid, sanitary service and a bibliography. The notes on field sanitation seem to be sound and practical.

The proceedings of the eighth annual convention of the National Association of Cement Users (now the American Concrete Institute) have been issued. This convention was held at Kansas City in March, 1912, but the publica-

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tion of its proceedings has been delayed for lack of funds. While the papers and discussions now printed are three years old, they include a mass of information which should be in every concrete engineer's library, not only to preserve the continuity of the Proceedings but also for the information furnished.

Descriptive Geometry

REVIEWED BY ALTON L. SMITH*

DESCRIPTIVE GEOMETRY FOR STUDENTS IN ENGINEERING SCIENCE AND ARCHITECTURE: A Carefully Graded Course of Instruction—By Henry F. Armstrong, Associate Professor of Descriptive Geometry and Drawing, McGill University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7x10 in.; pp. vi + 125; 114 illustrations. $2, net.

The author has arranged his material in three parts. Part I gives elementary ideas about projection, dealing with the representation of simple plane figures and presenting enough of geometrical theory to enable the student to work out easy problems on shadows cast by solids on plane and cylindrical surfaces. Part II takes up many of the usual descriptive problems on the line and plane and culminates in axometric and isometric projections and the sections of simple solids. Part III deals with problems on tangent planes, intersection and development of surfaces and the elements of linear perspective. A few exercise problems are given at the end of each chapter.

The book covers about the same ground as the course in mechanical drawing of the average technical high school. It would seem to the casual reader that the author, in avoiding the harder parts of the subject, has eliminated much that is very desirable for the training of the student of engineering. Warped surfaces, for instance, are not mentioned, although two surfaces of this class are briefly considered. Although the author states that practical applications should accompany and illustrate the geometrical principles, a cursory examination of the exercises does not reveal more than one or two direct applications to problems of the industrial world. There are many such applicable illustrations and they are quite essential to vivify a subject which otherwise appears lifeless to many students.

The use by the author of the first-angle grouping of projections, while the easiest for teaching, is at variance with the commercial drafting practice of this country. Most of the recent texts have employed the third-angle grouping, which is, of course, the only logical one. Considering contents and method of presentation, the book should prove much more useful to students of architecture than of engineering.

PICK, SHOVEL AND PLUCK: Further Experiences "With the Men who Do Things"—By A. Russell Bond, author of the "Scientific American Boy at School," "With the Men who Do Things," etc. New York: Munn & Co., Inc. Linen; 6x9 in.; pp. 249; 112 illustrations. $1.50; postage extra.

One of the ways of making engineers popular and of gaining appreciation from the public for engineering achievements is to arouse young America—to get our boys to turn from tales of soldiers, Indians and bloodshed to the no less remarkable performances of those who build our tunnels, bridges, skyscrapers and aqueducts.

To make a description of such works appeal to boys requires a peculiar talent as well as a wide and considerable knowledge of engineering. While we cannot look at this book from the point of view of young America, we can say that it is substantially accurate and unexaggerated from the engineering point of view.

The story is told as a narrative of a boy traveler who sees the Florida East Coast Ry. on concrete arches over the sea, the Panama Canal, the raising of a shipwrecked vessel, the Maine wreck coffer-dam, the Mississippi levees, and many other interesting engineering works and processes. It is a good book for sons of engineers anyway.

Industrial Gas Poisoning

GAS POISONING IN MINING AND OTHER INDUSTRIES—By John Glaister, M. D., Professor of Forensic Medicine and Public Health, University of Glasgow, and David Dale Logan, M. D., Surgeon to the Coltness Iron Works, Newmains. New York: William Wood & Co. Cloth; 6x9 in.; pp. xi × 471; 36 illustrations, plans and colored plates. $3.50, net.

There are few special medical books which interest engineers, but this volume contains so much engineering, industrial chemistry and law that it cannot fail to be a worthy addition to the gas engineer's library. While its legal and engineering aspects are British, yet much of these and all of the chemistry, pathology and therapeutics should be truly international and therefore of service to any American who directs gas works, gas-producer and gas-engine plants, mines, kilns, etc.

A large portion of the book is devoted to carbon-monoxide troubles. This is only natural since the production of this gas is so widespread and its dangers are so great as to merit all the attention here given it. The other gases with which common dangers exist—carbon dioxide and all its associates, methane, sulphureted hydrogen, products of explosives, etc.—are amply treated. There is, however, little or nothing on sulphurous or arsenical fumes, cyanogen, etc.

The authors first take up collieries—methods of working, ventilation, air conditions and gases. Underground fires and their detection and extinction form one chapter and coal-mine explosions another. Symptoms of afterdamp and explosive-fumes poisoning are given extended attention. Blast-furnace and producer-gas poisoning and symptoms are similarly taken up. The last-named class of troubles has largely to do with carbon monoxide. Study of this gas is continued by chapters on treatment of poisoning cases, detection of the gas in air, and its physiological effects. There are, finally, descriptions of rescue and resuscitation apparatus and a few paragraphs on mine rescue and aid operations.

Engineers will be interested in the appearance of a new series of law reports of as great utility to many of them as to their legal brethren. This is "Public Utility Reports," now being issued by the Lawyers Coöperative Publishing Co., Rochester, N. Y. The plan is to issue (1) fortnightly advance pamphlets containing syllabuses, opinions and annotations, and (2) bound volumes of the foregoing advance pages printed on India paper and appearing six or more times a year. The project starts with cases before both commissions and courts which have been decided since Jan. 1. The editorial work is in the hands of the publisher's permanent staff, under the direction of H. C. Spurr, well known for his work on "Lawyers' Reports Annotated." The collaboration was secured by A. S. Hills, formerly of the Bureau of Commission Research of the American Telephone &

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Telegraph Co., and now of the firm of Smith, Knowlton & Hatch, public-utility attorneys in Colorado Springs. Two issues of the advance sheets have appeared, showing a very wide range of electric, gas, telephone, water and transportation cases.

Steam-Engine Valve-Gears

REVIEWED BY JOHN V. MARTENIS*

VALVE GEARS—By Charles H. Fessenden, Assistant Professor of Mechanical Engineering, University of Michigan. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 170; 171 illustrations. $2 net.

It is difficult to find a book on valve-gears that is sufficiently comprehensive in treatment to serve as a general textbook. A course in the subject is usually dependent upon sectional requirements, and the administration of such a course will differ in various parts of the country.

The author states in his preface that it was his intention to present an elementary treatment of valve-gears. He adds: "Only steam-engine valve-gears are discussed, and while the effort has been made to cover the best known and most representative types, the aim has been to produce a book suitable as a text rather than a reference book." The subject is presented in a simple, satisfactory manner to meet the needs for which it is intended.

The introduction would be enhanced by a fuller discussion of the function of a valve. The use of both the Zeuner and the Bilgram diagrams in the solution of valve problems is commendable, and the value of either diagram in its application to specific problems is shown in the solution of numerous problems.

The discussion on port openings and passage areas is taken up in more detail than is usually found in a textbook on valve-gears. The chapter on shaft governors is rather meager; but this phase is considered more fully in any good text on steam engines, with which the student presumably is acquainted, making here an extended discussion unnecessary. The chapter on poppet valve-gears is advisedly introduced and adds materially to the scope of the book as a text.

The fact that the book contains the essentials of many of the commonly used types of valves without any attempt at involved mathematical treatment places the subject of valve-gears within the grasp of the average person.

The illustrations from line drawings are excellent, which cannot be said of the reproductions from manufacturers' cuts. There appears to be no portion of the work that could be omitted without seriously affecting the value of the book.

Internal-Combustion Motors

GAS, GASOLINE AND OIL-ENGINES—By Gardner D. Hiscox, author of "Mechanical Movements," "Compressed Air," etc. Revised, enlarged and brought up to date by Victor W. Page, author of "The Modern Gasoline Automobile," etc. 21st Edition. New York: The Norman W. Henley Publishing Co. Cloth; 7x10 in.; pp. 640; 435 illustrations. $2.50, net.

Mr. Page has started with the substantial foundation of one of the more successful popular treatises on internal-combustion motors and by a well executed revision has made the book even correspondingly better for this day than the original form was in its time.

Theory is not penetrated deeply, but probably enough for the practical-minded readers whom the book seems intended to reach. The fundamental thermodynamics of internal-combustion motors are outlined simply. Then the physics and chemistry of the fuels used are introduced; this section, and a few allied ones at the end, will be particularly interesting and illuminating to most readers, though not of the immediate importance of some of the other parts. The rest of the book, nearly 80%, treats of a great variety of matters of practical importance to various engine users—dimension ranges, governors, valve gears and miscellaneous details of design, ignition, electrical auxiliaries, lubrication, cooling, capacity ratings, stationary-installation requirements, stationary gas-fuel types, marine-engine examples, kerosene- and heavy-oil units, including the more important Diesel designs, farm and tractor types, machines for electric stations, automobile and airship engines, etc.

City Charter Essentials

MUNICIPAL CHARTERS: A Discussion of the Essentials of a City Charter with Forms or Models for Adoption—By Nathan Matthews, Mayor of Boston, 1891-1895; Chairman, Boston Finance Commission, 1907-1909; Lecturer on Municipal Government in Harvard University. Cambridge: Harvard University Press. Cloth; 6x9 in.; pp. vii + 210. $2.

Drawing upon a large fund of experience, observation and reflection gained while acting as mayor, municipal investigator, charter-amendment framer, lawyer in private practice, and public-spirited citizen, Mr. Matthews has produced a unique, valuable, concise, logical and clear exposition of what a city charter should be—as he sees it.

The book consists of (1) a closely reasoned exposition of the essentials of a charter; (2) a charter draft in accordance with the ideas of the author, followed by a skeleton for changing this draft into one of the commission type; and (3) notes on the drafts. The work is an extension of lectures given in the Department of Government in Harvard University in 1911-12. Emphasis is laid on administrative rather than political provisions.

Briefly, Mr. Matthews' charter draft provides for an unpaid council of seven members having legislative powers only, and a mayor with sole power of appointment of all other leading executive officers and with absolute veto power over all other acts of the council. The city engineer and other heads of divisions (but not heads of departments) would be appointed from civil-service examination lists and would hold office until death, resignation or removal. The city engineer, although a division head under the commissioner of public works, would have charge of all engineering for the commissioners of public safety and municipal property, as well as for any and all other departments.

The charter draft contains rigid provisions against doing any but minor construction work by city labor. Municipal-ownership ventures must be authorized twice, at intervals of not less than a year, by the council and mayor, and then by popular vote. Before the popular vote is taken the project must be reported on by the state utility commission and the report mailed to every voter of record. These several restrictions on one side are partly offset on the other by rigid provisions against paying for anything but replacement value of physical property when buying water, light or other utility plants. The draft also contains rigid provisions controlling the financial operations of municipally owned utilities.

Perhaps enough has been said to show that this book is an unusual combination of the conservative and the

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radical. If space permitted it would be easy to show that it also includes principles of wide general acceptance alongside some that have not yet been adopted outside of Massachusetts, and with others that have not gone far, if at all, beyond the personal conception of the author. All this adds interest to a volume which contains far more than our space permits us to set forth regarding many fundamentals of good city government.

Refrigerating Apparatus

SANITARY REFRIGERATION AND ICE-MAKING—By J. J. Cosgrove, author of "Principles and Practice of Plumbing," "Sewage Purification and Disposal," "History of Sanitation," "Wrought Pipe Drainage Systems," "Plumbing Plans and Specifications," "Plumbing Estimates and Contracts," "Design of the Turkish Bath," "Rock Excavating and Blasting." Philadelphia, Penn.: Technical Book Publishing Co., 215 West Pomona St., Germantown. Cloth; 6x9 in.; pp. 331; 103 illustrations. $3.50.

Author and publisher have combined their efforts to produce a pleasing and interesting volume which should be of great value to the particular class of readers whom it is intended to reach—architects, superintendents and engineers not expert in the design and construction of refrigerating apparatus. The book might almost be called "popular" in its treatment, were it not for the large amount of specific data which are collected within its pages. There is practically no mathematics involved in the discussions, although a few expressions of general laws are given in mathematical form for brevity. The descriptions are clear and concise; the illustrations are unusually good for a book of this sort, owing largely to the suppression of catalog cuts and the substitution therefor of what appear to be original sketches made after the approved practice of the best technical journals.

About 20% of the volume is given up to a review of scientific matters on which the art of refrigeration rests, including heat phenomena, properties of gases and refrigerants. A little over 20% is given up to the ammonia-compression system, which is gone into in considerable detail. Something like 10% is allowed for the discussion of the insulation of cold-storage rooms, the amount of refrigeration required for different services, etc. Following this is a review of the advantages and disadvantages of using a brine-circulating system to distribute the cold fluid in place of direct use of ammonia. The other pressure systems are briefly dismissed with a statement of their main differences from ammonia systems.

Only some 8% of the book is needed to present the absorption scheme of artificial refrigeration, but the theory and practice seem to be set forth in that limited space sufficiently for the purposes of this work.

The remainder of the volume, approximately a quarter of the whole, deals with such practical topics as ice-making, cold-air circulating systems, small outfits, use of refrigeration in breweries and for difficult excavation, water purification for ice-making, plant erection and operation, common rates for refrigeration service, and cold-storage temperatures.

HISTORY OF RENSSELAER POLYTECHNIC INSTITUTE, 1824-1914—By Palmer C. Ricketts, M. Am. Soc. C. E., President and Director of Rensselaer Polytechnic Institute. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xii + 269; illustrated. $2.50, net.

This is the second edition of a book originally published in 1895 and reviewed in ENGINEERING NEWS, July 18, 1895. The new edition has many new illustrations and brings the history of this first American civil engineering college to date. The book is intended primarily for alumni of the institution; but the early history of the Rensselaer Polytechnic Institute is so intimately associated with the history of the profession that the book is a welcome addition to the very meager literature of American engineering history.

Water-Supply and Purification

WATER SUPPLIES; Their Purification, Filtration and Sterilization: A Handbook for the Use of Local and Municipal Authorities—By Samuel Rideal, Public Analyst for the Metropolitan Borough of Chelsea, England, and author of "Disinfection and Disinfectants;" and Eric K. Rideal. New York: D. Appleton & Co. Cloth; 6x9 in.; pp. xii + 274; 10 text illustrations, 24 plates. $2.50, net.

The authors undertook to "summarize the science and practice of modern water-supply and water purification." To this end they have drawn widely from European and American publications and from their own wide experience as analysts and sanitarians.

They first discuss the inorganic constituents of natural waters and various animal and vegetable impurities. Next they consider sources of water-supply, distribution, storage, preliminary purification, sand and mechanical filtration, softening and the various means of sterilization or disinfection. A chapter on analyses and their interpretation and some tabular appendixes are given.

For Americans, at least, the book would have been quite as useful and handier had the authors had the courage to plunge more directly into their real subject—water purification—and to omit even there a considerable amount of material dealing with agents and processes which are not used or likely to be used in general water-works practice.

Altogether, the water-purification part of the book is a valuable addition to water-works literature. It fills a gap which has been growing as earlier books have been getting out of date. The material which appears to us to be of little use is attributable to extensive abstracting. It can easily be skipped. Perhaps some of it will, after all, prove to be unexpectedly useful.

CONCRETE STONE MANUFACTURE—By Harvey Whipple, Managing Editor, "Concrete-Cement Age." Detroit, Mich.: Concrete-Cement Age Publishing Co. Flexible leather; 4x7 in.; pp. 255; 126 illustrations. $1, postpaid.

The early promise of the concrete block has not been fulfilled. Ten years ago technical literature was full of the coming of the new material which bade fair to drive stone and brick into retirement; today the concrete block has only a minor place among structural material. In spite of this, those blocks which are being made are far superior to those which flooded the country ten years ago, and, in addition, a great quantity of concrete stone is being made, mainly for decorative purposes. Mr. Whipple's book, noted above, is devoted to the latest developments in these products and is in every sense a working manual. Those who expect to make a success in the concrete block or concrete stone business would do well to have the book for consultation and study.

THE ART OF ESTIMATING THE COST OF WORK, With Specific Reference to Unstandardized Operations as in Jobbing Shops or Repair Work—By William B. Ferguson, Naval Constructor, U. S. N. New York: The Engineering Magazine Co. Cloth; 5x8 in.; pp. 97; illustrated. $1.

Naval Constructor Ferguson has outlined a scheme, found of service in the Hull Division, for estimating closely the cost of proposed construction and repair. He reduces each task to certain prime operations which ap-

pear in various combinations throughout U. S. Navy Yard activities. Then he distributes the cost data, which have been carefully kept from day to day, and evolves certain relations between cost and conditions of work so that the results may be made applicable to other jobs in the same yard. He plots, for example, curves between cost and number of construction units, which display past experience and, therefore, expected future performance. All this is illustrated by numerous data on hull work.

DRAKE'S TELEPHONE HANDBOOK; A Book for the Practical Man—By David Penn Moreton, Associate Professor of Electrical Engineering, Armour Institute of Technology. Chicago: Frederick J. Drake & Co. Cloth; 4x7 in.; pp. 286; 161 illustrations. $1, net.

About a third of the book is virtually a very elementary treatise on direct- and alternating-current circuits, measurements and appliances, and on sound. The rest gives simple descriptions of telephone systems and shows overhead and underground line construction.

A directory of State and Insular Health Authorities of the United States is published in "Public Health Reports" for Apr. 2, 1915 (Washington, D. C., U. S. Public Health Service).

An interesting collection of views of the Riensch-Wurl sewage and trades-wastes screen, with explanatory titles and notes and a partial list of foreign installations, has been issued by The Sanitation Corporation, 50 Church St., New York City.

Operating details of receiving and delivering 398,421 acre-feet of water and of maintaining 333 mi. of canals are given in the 1914 annual report of Ray S. Carberry, Superintendent Imperial Water Co. No. 1, Imperial, Calif. Copies of the report may be had for the asking.

A unique bit of student work has come to us under the title "Notes for a Study in City Planning in Champaign-Urbana." Sanitation, transportation, main and secondary streets, street trees, parks and playgrounds are each reported on briefly. The work was done under the guidance of Charles Mulford Robinson, Professor of Civic Design in the University of Illinois. It is published by the Division of Landscape Gardening, University of Illinois, Champaign. The price is 25c.

Wide publicity is given to the Annual Report of Richard Messer, Sanitary Engineer of the State Board of Health of Virginia, by printing it as the sole contents of the Virginia Health Bulletin for Mar. 20, 1915 (Richmond, Va.). After some general statements on water-supply and the disposal of sewage and manufacturing wastes, the report is devoted to brief accounts of sanitary inspections, arranged alphabetically by localities.

All Massachusetts cities and all towns of 10,000 population and upward in that state must have city-planning commissions. That the City-Planning Commission of Springfield, Mass., takes its task seriously is shown by its first annual report (164 pp.) and by the fact that it held "41 regular meetings" from Oct. 10, 1913, the date of its organization, to Dec. 1, 1914. The report just issued contains information on matters which have a bearing upon future city planning for Springfield.

A handy and useful pamphlet, entitled "Standard Specifications for Steel Rails," has been issued by Robert W. Hunt & Co., Insurance Exchange, Chicago. Besides giving a list of 26 specifications, with 1913-15 dates, and two tabular summaries, the pamphlet contains the specifications of the American Railway Association, the American Society for Testing Materials, the Colorado Fuel & Iron Co. and the Manufacturers' Standard Specifications for Openhearth Rails. Furthermore, the publishers kindly stated that "copies of specifications not printed in this pamphlet will be furnished on request."

Topographic maps of the Philippine Islands, prepared in the Geographic Division of the Insular Bureau of Surveys under P. A. Welker, Director of Coast Surveys, and printed at the Coast and Geodetic Survey office at Washington, may be obtained from that office or from the Coast and Geodetic Survey sub-office at Manila. They are in colors and on a scale of 1 to 200,000. The sizes within borders are 50x32, 44x36, 32x30, 38x35 and 43x24 in. Elevations are shown by hachures and the principal heights are given in figures—in meters above mean sea level. A map is in preparation which will cover the entire archipelago on a scale of 1 to 1,000,000, which will conform to the plan adopted by the International Geographic Congress for an atlas of the world.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale, and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

THE A B C OF IRON AND STEEL, With a Directory of the Iron and Steel Works and Their Products of the United States and Canada—Edited by A. O. Backett. Cleveland, Ohio: The Penton Publishing Co. Cloth; 8x11 in.; pp. xv + 338; 222 illustrations. $5, postpaid.

ABSTRACT OF SPECIAL BULLETINS: WEALTH, DEBT AND TAXATION For 1913—Washington, D. C.: Bureau of the Census. Paper; 9x12 in.; pp. 63.

AN ACCOUNT OF THE WORK OF THE ART COMMISSION OF THE CITY OF PITTSBURGH From Its Creation in 1911 to Jan. 1, 1915. Paper; 6x9 in.; pp. 71; illustrated.
Besides the statute authorizing the Commission, the by-laws governing its action and an account of its approval or disapproval of bridges, buildings and memorials, the pamphlet contains a report by E. H. Bennett, Consulting Architect, Chicago, in which he submits a plan for developing the Point and waterfront at the junction of the rivers at Pittsburgh.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION: Proceedings for 1914—New York: Secretary, E. B. Burritt, 29 West 39th St. Cloth; 6x9 in.; pp. 555; illustrated.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings of the 24th Annual Convention—Chicago, Ill.: Secretary, C. A. Lichty, 319 No. Waller Ave. Paper; 6x9 in.; pp. 308; illustrated. $1.
Reports are included on the following subjects: Ice Houses, Warnings (Bridges, etc.), Reinforced-Concrete Bridge Work, Mechanical Coaling Stations, Street-Crossing Elimination, Water-Supply (Pipe Lines), Concrete Poles, Poles and Signs.

ANNUAL REPORT OF THE MISSISSIPPI RIVER COMMISSION For the Fiscal Year Ending June 30, 1913—Being Appendix JJJ to the Annual Report of the Chief of Engineers of the United States Army, Washington, D. C. Paper; 6x9 in.; pp. 361; illustrated.

AUSTRALIAN POCKET COMPENDIUM OF COMMONWEALTH OFFICIAL STATISTICS (1914)—Melbourne: Commonwealth Bureau of Census and Statistics. Paper; 3x4 in.; pp. 128. Sixpence (postage extra).

BULLETINS OF THE ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS, Vol. X, Nos. 68-74 (July, 1913—April, 1914)—Urbana: The University. Heavy cardboard; 6x9 in.

CANADIAN REPORT OF PROGRESS OF STREAM MEASUREMENTS For 1913—By P. M. Sauder, Chief Hydrographer, Assisted by G. H. Whyte and G. R. Elliott. Ottawa, Ont.: Irrigation Branch, Department of the Interior. Paper; 7x10 in.; pp. 414; illustrated.

CENTRIFUGAL PUMPS—By R. L. Daugherty, Assistant Professor of Hydraulics, Sibley College, Cornell University; author of "Hydraulic Turbines." New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 192; 111 illustrations. $2, net.

CONNECTICUT PUBLIC UTILITIES COMMISSION: Third Annual Report, Including the Financial Reports of All Public Service Companies for the Year Ending June 30, 1914, with Statistical Tables Relating Thereto—Hartford, Conn.: Secretary, Henry F. Billings. Cloth; 6x9 in.; pp. 838.

DESIGN OF STEEL BRIDGES: Theory and Practice for the Use of Civil Engineers and Students—By F. C. Kunz, M. Am. Soc. C. E., formerly Designer for the Bridge and Construction Department of the Pencoyd Iron Works and the American Bridge Co. and Chief Engineer of the Bridge and Construction Department of the Pennsylvania Steel Co. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xxiv + 472; illustrated. $5, net.

DIRECTIONS FOR DESIGNING, MAKING AND OPERATING HIGH-PRESSURE TRANSFORMERS—By Prof. F. E. Austin, Head of the Department of Electrical Engineering in the Thayer School of Engineering, Dartmouth College, Hanover; author of "Examples in Magnetism," "Examples in Alternating-Currents," "How to Make a Transformer for Low Pressures." Hanover, N. H.: The Author, Box 41. Paper; 5x8 in.; pp. 46; 21 illustrations. 50c., postpaid.

Shows the calculations for small and simple step-up transformers which the reader can make from materials easily obtainable. Simple directions for construction.

ELECTRIC RAILWAY HANDBOOK: A Reference Book of Practice Data, Formulas and Tables for the Use of Operators, Engineers and Students—By Albert S. Richey, Fellow, Am. Inst. E. E., Consulting Engineer, Professor of Electric Railway Engineering, Worcester Polytechnic Institute; Assisted by William C. Greenough. New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 4x7 in.; pp. xi + 832; illustrated. $4, net.

FEDERAL VALUATION OF RAILROAD PROPERTY — By Richard J. McCarty, M. Am. Soc. C. E., M. Am. Soc. M. E., Kansas City, Mo.: The Author, 3820 Warwick Boulevard. Paper; 6x9 in.; pp. 103.

500 PLAIN ANSWERS TO DIRECT QUESTIONS on Steam, Hot Water, Vapor and Vacuum Heating: The Science and Practice of Heating Explained in a Series of Plain Questions and Answers, with Tables, Rules and General Information, Forming a Complete Text Book and Manual. A Help to the Apprentice and Journeyman Steam Fitter in Preparing for Examination. A Reference Book for Master Steam Fitters, Architects and Heating Contractors —By Alfred G. King, author of "Practical Steam and Hot Water Heating," "Practical Heating Illustrated," etc. New York: The Norman W. Henley Publishing Co. Cloth; 6x9 in.; pp. 214; 127 illustrations. $1.50.

GEOLOGIC ATLAS OF THE UNITED STATES—Washington, D. C.: U. S. Geological Survey. Paper; 18x22 in.; illustrated.

Folio No. 191: Raritan, N. J. By W. S. Bayley, R. D. Salisbury and H. B. Kümmel. Pp. 32.

Folio No. 192: Eastport, Me. By Edson S. Bastin and Henry S. Williams. Pp. 15.

Folio No. 193: San Francisco, Calif. By Andrew C. Lawson. Pp. 24.

Folio No. 194: Van Horn, Tex. By G. B. Richardson. Pp. 9.

GROUND WATER IN SOUTHEASTERN NEVADA—By Everett Carpenter. Washington, D. C.: U. S. Geological Survey. Water-Supply Paper 365. Paper; 6x9 in.; pp. 86; illustrated.

HANCOCK'S APPLIED MECHANICS FOR ENGINEERS—Revised and rewritten by N. C. Riggs, Professor of Theoretical and Applied Mechanics in the School of Applied Science of the Carnegie Institute of Technology. New York: The Macmillan Co. Cloth; 5x8 in.; pp. viii + 441; 289 illustrations. $2.40.

HEAT ENGINEERING: A Textbook of Applied Thermodynamics for Engineers and Students in Technical Schools—By Arthur M. Greene, Jr., Professor of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute; Sometime Junior Dean, School of Engineering, University of Missouri. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 462; 198 illustrations. $4, net.

HIGHWAY BONDS: A Compilation of Data and an Analysis of Economic Features Affecting Construction and Maintenance of Highways Financed by Bond Issues, and the Theory of Highway Bond Calculations—By Lawrence I. Hewes, Chief, Economics and Maintenance, Office of Public Roads, and James W. Glover, Professor of Mathematics and Insurance, University of Michigan, Collaborator. Washington, D. C.: Office of Public Roads. Paper; 6x9 in.; pp. 136; illustrated.

HOW TO MAKE A LOW-PRESSURE TRANSFORMER—By Prof. F. E. Austin, Head of the Department of Electrical Engineering at Norwich University; Director of the Department of Electrical Engineering, Thayer School of Civil Engineering, Dartmouth College, Hanover; author of "Examples in Direct-Current Engineering," "Examples in Alternating-Current Engineering." Hanover, N. H.: The Author, Box 41. Paper; 5x7 in.; pp. 14; illustrated. 25c., postpaid.

Some easy directions for the assembly of parts by a 100-watt 110/8 to 64-volt experimental transformer.

INFORMATION AND SUGGESTIONS FOR CITY AND TOWN PLANNING BOARDS—Bulletin No. 2, November, 1914, of the Massachusetts Homestead Commission. Boston: Henry Sterling, Secretary, State House. Paper; 6x9 in.; pp. 11.

The Massachusetts legislature of 1913 made it the duty of every city and town of 10,000 population and upwards to create a planning board and provided that the Homestead Commission should have advisory supervision of the boards. This bulletin contains advice regarding the general line of activities which should be undertaken by such boards.

INVESTIGATION OF FLOW THROUGH FOUR INCH SUBMERGED ORIFICES AND TUBES—By Leland Rella Balch, Research Assistant in Hydraulic Engineering, University of Wisconsin. Madison, Wis.: Engineering Experiment Station, University of Wisconsin. Bulletin No. 700. Paper; 6x9 in.; pp. 31. 25c.

LAND GRANT COLLEGE ENGINEERING ASSOCIATION: Proceedings of the Third Annual Meeting—East Lansing, Mich.; Secretary, G. W. Bissell, Michigan Agricultural College. Paper; 6x9 in.; pp. 170.

MASSACHUSETTS STATE BOARD OF HEALTH—Annual Report For 1913. Boston: Dr. Mark W. Richardson, Secretary. Cloth; 6x9 in.; pp. 790.

MODERN BRITISH PERMANENT WAY; Treating of Rails, Chairs, Fishbolts, Fishplates, Keys, Sleepers, Ballast, Rail-Joints, Points and Crossings, Etc.—By Cecil J. Allen. London: "The Railway News," 91 Temple Chambers, Temple Ave. Cloth; 8x10 in.; pp. xvii + 147; 50 illustrations. Six shillings, net.

NEBRASKA STATE BOARD OF IRRIGATION, HIGHWAYS AND DRAINAGE: Tenth Biennial Report (1913-1914)—By Donald D. Price, State Engineer, Lincoln, Neb. Cloth; 6x9 in.; pp. 356; illustrated.

NEW ZEALAND OFFICIAL YEAR-BOOK (1914)—Wellington, N. Z.: Malcolm Fraser, Government Statistician. Cloth; 6x9 in.; pp. 1017.

THE OFFICIAL GOOD ROADS YEAR BOOK OF THE UNITED STATES (1915)—Washington, D. C.: American Highway Association, Colorado Bldg. Cloth; 6x9 in.; pp. x + 498. $1, or $4 for five copies, postpaid.

OKLAHOMA GEOLOGICAL SURVEY BULLETIN NO. 22—Norman, Okla.; C. W. Shannon, Director. Part I., Director's Biennial Report to the Governor of Oklahoma, 1914. Part II., Mineral Resources of Oklahoma and Statistics of Production From 1901 to 1914. Paper; 6x9 in.; pp. 142; illustrated.

OPINIONS AND DECISIONS OF THE WISCONSIN RAILROAD COMMISSION, Vol. XII, May 20 to Nov. 4, 1913—Compiled by Lewis E. Gettle, Secretary, Madison, Wis. Cloth; 6x9 in.; pp. xxx + 879.

PUBLIC RECREATION: Bulletin of the University of Wisconsin—Madison: Extension Division of the University. Paper; 5x8 in.; pp. 217. $1.

Besides descriptions and discussions of various forms of public recreation, many references to articles and books on the subject are given.

REPORT OF THE STATE GEOLOGIST OF VERMONT For 1913-1914—Burlington, Vt.: George H. Perkins, State Geologist and Professor of Geology, University of Vermont. Cloth; 6x9 in.; pp. 448; illustrated.

REPORT ON THE BUILDING AND ORNAMENTAL STONES OF CANADA, Vol. III—By Wm. A. Parks. Ottawa, Ont.: Mines Branch, Canada Department of Mines. Paper; 7x10 in.; pp. 304; illustrated.

SIXTH BIENNIAL REPORT OF THE STATE ENGINEER AND OF THE CAREY LAND ACT BOARD OF MONTANA (1913-1914)—Helena, Mont. Paper; 7x10 in.; pp. 305; illustrated.

SOME DEEP BORINGS IN ILLINOIS—By J. A. Udden. Urbana, Ill.: State Geological Survey, University of Illinois. Bulletin No. 24. Cloth; 6x9 in.; pp. 141; illustrated.

SOME MEASURING DEVICES USED IN THE DELIVERY OF IRRIGATION WATER—By California Agents of Irrigation Investigations, Office of Experiment Stations, U. S. Department of Agriculture. Berkeley: College of Agriculture, University of California. Bulletin 247. Paper; 6x9 in.; pp. 180; illustrated.

Among the devices described are some of the newer ones. Some weir-discharge tables are given.

STATISTICS OF EXPRESS COMPANIES IN THE UNITED STATES—Fifth Annual Report for Year Ended June 30, 1913. Washington, D. C.: Division of Statistics. Interstate Commerce Commission. Paper; 8x11 in.; pp. 40.

TYPHOID FEVER IN ROCKFORD, ILL.—By Paul Hansen and Horatio N. Parker. [Reprinted from "The Journal of Infectious Diseases," Vol. 16, No. 1, January, 1915, pp. 1-23.] Urbana, Ill.: The Authors, University of Illinois. Paper; 7x10 in.; illustrated.

UNIVERSAL SAFETY STANDARDS: A Reference Book of Rules, Drawings, Tables, Formulæ, Data and Suggestions for Use of Architects, Engineers, Superintendents, Foremen, Inspectors, Mechanics and Students—By Carl M. Hansen, M. Am. Soc. M. E., Consulting Safety Engineer. Compiled under the Direction of and Approved by the Workmen's Compensation Service Bureau, New York. Second edition, revised and enlarged. New York, Philadelphia and London: Universal Safety Standards Publishing Co. Flexible leather; 5x8 in.; pp. 312; illustrated. $3, net.

VILLAGE IMPROVEMENT—By Parris Thaxter Farwell, Chairman of the Village Improvement Committee of the Massachusetts Civic League. New York: Sturgis & Walton Co. [The Farmer's Practical Library.] Cloth; 5x8 in.; pp. xi + 362; illustrated. $1, net.

WATER RIGHTS BRANCH, DEPARTMENT OF LANDS OF BRITISH COLUMBIA: Report for 1914—Victoria, B. C.: The Department. Paper; 7x10 in.; pp. 31; illustrated.

WATER SUPPLY COMMISSION OF PENNSYLVANIA: Annual Report for 1913—South Bethlehem, Penn.: Secretary, Thomas J. Lynch. Cloth; 6x9 in.; pp. 312; illustrated.

WATER-SUPPLY, SEWERAGE AND DRAINAGE DEPARTMENT OF WESTERN AUSTRALIA: Second Annual Report (1913-14)—Perth, W. A.: The Department. Paper; 8x13 in.; pp. 104; illustrated.

WHO BUILT THE PANAMA CANAL?—By W. Leon Pepperman, Chief of Office of Administration of the Second Isthmian Commission. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. xiv + 417; illustrated. $2, net.

WORKING DATA FOR IRRIGATION ENGINEERS—By E. A. Moritz, Assoc. M. Am. Soc. C. E., Engineer U. S. Reclamation Service. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xiii + 395; 46 illustrations; 65 tables. $4, net.

Field and Office

Special Features in Forms for Concrete Buildings

The system of adjustable forms employed by J. E. Hodges & Co., of Cincinnati, Ohio, in the construction of reinforced-concrete buildings includes (1) adjustable shores or struts, (2) a flexible mat which supports metal sheets constituting the bottom of the slab forms, and (3) column forms adjustable to various sizes. These devices are shown in Fig. 1, while Fig. 2 shows the shores in place adjacent to one of the column forms.

The shore is made adjustable by means of a kind of ratchet-jack arrangement. The lower portion of the shore is a single stick about 4 in. square, sliding between two sticks 2x4 in. which form the upper portion and are connected by braces and a cap. A pair of heavy straps around the shore carries cams which lock the sliding sections securely together in any position.

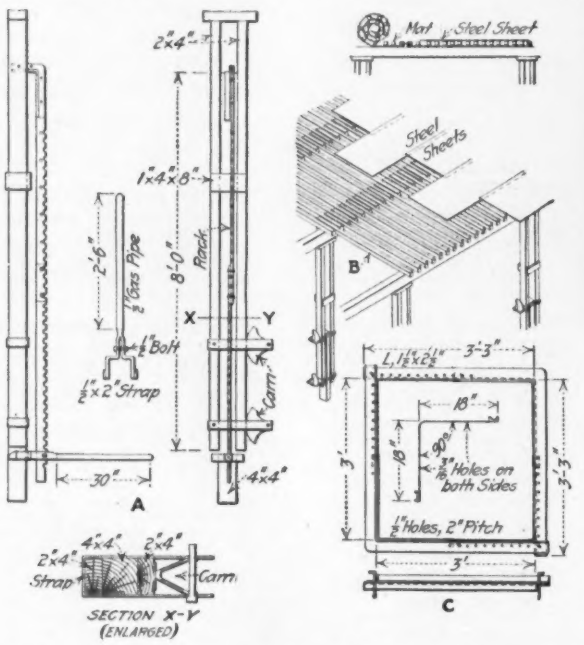


FIG. 1. ADJUSTABLE PARTS FOR FORMS FOR CONCRETE BUILDING CONSTRUCTION

(A, Shore and shore jack. B, Flexible mat for floor slabs. C, Column form)

The 4x4-in. stick has attached to one face a steel bar notched to form a rack. To adjust the length, in leveling the centering for the floor, a fork-ended lifting lever is fitted over the timber, with its fulcrum bolt resting in one of the slots of the bar and the ends of the fork engaging the lower ends of the 2x4-in. sticks. With the cams loosened, the upper portion of the shore is raised by bearing down on the lever handle, and when in proper position is locked by the cams. This construction dispenses with the use of wedges.

For the floor or slab forms, flexible mats made of slats wired together are used, and these are adjustable in length by the telescoping of the slats, as shown. They are covered with plates of sheet metal to hold the concrete. When not in use, the mats are rolled up in bundles convenient for handling and for transportation.

The adjustable form for square columns has four sheets of galvanized steel, bent at right angles and placed together with ends overlapping. The edges of the outer sheets are stiffened with small vertical channels. The struts

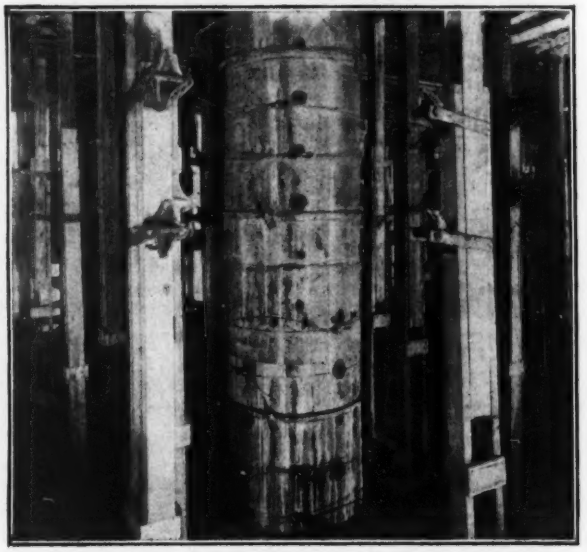


FIG. 2. ADJUSTABLE SHORES AND COLUMN FORMS FOR CONCRETE BUILDING CONSTRUCTION

are pairs of angles, bent to L-shape, and lapping at two diagonally opposite corners. The lapping ends are punched with holes to receive a key or pin. For circular columns (Fig. 2) two semicircular sheets are used, the form being brought to shape by outside bands or templates. Intermediate flexible bands strengthen the form, and these can be applied to forms of any size.

Dogs in Temporary Structures

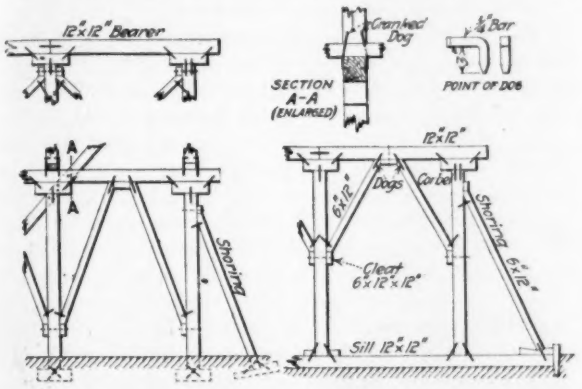
BY LEONARD GOODDAY*

Iron dogs have been used in temporary structures, rough staging and shoring for many years in Europe, Australia and Africa. They are especially useful where the timbers butt against each other (the best practice) and where structures are built of logs and half-logs, i.e., where the scantling is 12x12 and 6x12 in.

In the erection of large masonry structures, where the stone blocks are of great weight the scaffolding is framed of square timbers fastened by bolts and dog-irons (commonly called dogs) and set quite independent of the walls.

*Civil and Mechanical Engineer, 552 O'Connor, Ottawa, Can.

These dogs are pieces of square or round iron about ¾ in. in diameter, or width, with the ends pointed or chisel-edged and turned down about 3 in. at right-angles to the shank, as shown in a detail in the accompanying drawing. The writer prefers irons ¾ in. square with a chisel-



CORRECT PLACING OF DOGS IN STAGING

edge about ¼ in. wide. Such dogs can be driven and removed with little or no injury to the lumber.

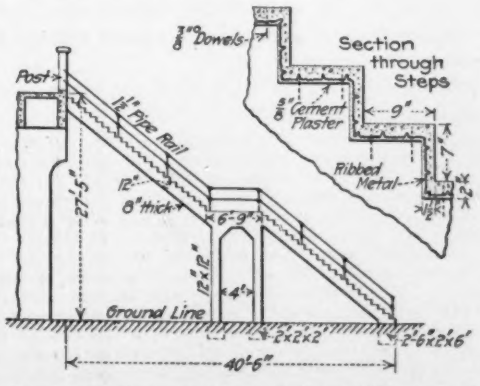
For short staging, the dogs are often fixed parallel to the scantlings held down. Sills are connected by one or two dogs on each side and top. The dogs are placed at an angle of about 45° when connecting uprights to sills, crossbracing, and struts, or bearers to corbels and struts. Dogs connecting footblocks with posts are cranked as shown by a detail. At every joint, the dogs are placed on both sides, opposite each other. They should not be fixed within four times their width, or diameter, from the edge of the scantling.

Building Reinforced-Concrete Steps without Forms

BY R. C. HARDMAN*

In the reinforced-concrete stairway shown in detail in the accompanying drawing, the treads and risers were built without forms, using the reinforcing metal as a self-supporting medium on which to lay the concrete. The stairway is in two flights, with an intermediate landing. The risers are 7 in.; the treads, 9 in., and the out-to-out width of the stairway is 6 ft.

*Civil Engineer, Colorado Springs, Colo.



CONCRETE STAIRWAY WITH SELF-SUPPORTING REINFORCEMENT

Contrary to the usual method of building such stairways as monoliths, the stringers and the landing were constructed first on the usual forms. The stringers, two in number for each flight, are 8x12-in. minimum section, and are reinforced with two straight ¾-in. round bars and one trussed ¾-in. round, with stirrups of ⅜-in. rounds. The columns for the landing are reinforced with four ⅝-in. rounds, hooped with No. 9 wire spaced 4 in. c. to c. The kneebraces at the tops of columns are reinforced with two ⅝-in. rounds. The landing floor is not reinforced, but is carried by a groined vault formed by the kneebraces.

In building the forms for the beams, the notchings for the treads and risers were made 2 in. below the finished grade for the treads and 1½ in. back of the finished face of the risers. In each tread support were placed two short pieces of ⅜-in. rounds to act as dowels for tying on the finished treads. At proper intervals, 8-in. sections of 2-in. pipe were placed to receive later the railing posts of 1½-in. pipe.

In forming the finished steps, 24-gage ribbed expanded metal, having four $\frac{13}{16}$-in. ribs to the foot, was bent into place around the notched tops of the supporting beams, as shown in the accompanying detail. The sheets of metal were cut to a length of 5 ft. 10 in. to allow for a 1-in. play on either end for irregularities in bending. Where the dowels were encountered, they were driven through the metal with a hammer, and by slitting the end of the metal sheets, they were fitted around the railing posts, which previously had been placed.

The expanded metal was then covered with 1:2:4 concrete to a depth of 2 in. on the treads and to a thickness of 1½ in. on the risers, which was worked to a float finish. The under and back sides were then plastered with cement mortar to a thickness of ⅝ in.

The labor of placing and bending the sheet metal was slight, as the metal bends very easily parallel to the ribbing. The cost of placing the concrete was but little more than placing a top coat on steps built in the ordinary way.

The stairway was designed and built by the writer, as engineer for the Central Construction Co., of Colorado Springs, Colo.

Tunnel Waterproofing with Cement-and-Clay Mortar

A novel waterproofing method, in which an impervious layer of cement and clay was interposed between water-bearing ground and a concrete structure, was used in the recent addition to the Pavonia Ave. station of the Hudson & Manhattan R.R. in Jersey City, N. J. The work consisted in the excavation by tunneling methods and a subsequent lining with concrete of a station opening in a water-bearing stratum 200 ft. from the Hudson River bulkhead line and 50 ft. below mean sea level. It was imperative that the concrete lining be water-tight, but it had been the experience of the engineers in building the original tunnel that it was impossible in working under air pressure to use any applied waterproofing mats on account of the danger to workmen from fumes; expected expansion and contraction with consequent cracks forbade the use of any integral method of waterproofing.

It had been noted that all of the river tunnels which rest in river clay were quite water-tight, and it was be-

lieved that if a complete coating of clay could be obtained exterior to the tunnel lining, no more nearly perfect or complete waterproofing could be secured. The difficulty with any clay application was that when wet and soft the clay would change its form by squeezing. Therefore, experiments were made with clay mixed with sufficient portland cement to hold its form when set. These experiments produced an impervious material, so further trials were made by mixing dried Hudson River silt and portland cement in equal quantities, making, with the addition of water, a sort of plaster. These further tests proved so successful that the method outlined below was adopted for the waterproofing of the entire station opening.

Hudson River silt, which is a finely pulverized clay with a considerably larger proportion of silica than ordinary clay, was dried and, mixed with equal proportions of portland cement, applied through the medium of a cement-gun as a heavy coating on every portion of exposed timbering and lagging in the tunnel. This produced a layer of impervious plaster about two inches thick against which the concrete lining of the tunnel was placed. The method has proved successful, the station structure being practically dry under an extreme head of salt water.

In applying the coating considerable trouble was found with dusting from the cement-gun at the beginning of an application. As soon as the water from the gun properly mixed with the cement and clay, this dusting nuisance disappeared, and by plastering at such times as certain stages of the work were not actively under construction and when very few men needed to be in the chamber, and also by equipping the men with respirators which protected their breathing, the work was carried on without much difficulty.

The construction was in charge of Jacobs & Davies, Inc., Consulting Engineers, New York; J. V. Davies, of the firm, states that he is thoroughly satisfied with the results obtained and would unquestionably repeat the method under similar conditions.

⌘

Diagram for Estimating Flow in Channels and Conduits

By Gilbert D. Fish*

The accompanying diagram, based on the Kutter formula for hydraulic coefficients, was devised by the writer for estimating velocities of flow in rivers, canals, flumes and pressure conduits. It provides a graphical means of applying the Kutter formula, which is too complex to be well adapted to computation:

$$V = \frac{\frac{1.811}{N} + 41.6 + \frac{0.00281}{S}}{1 + \left(41.6 + \frac{0.00281}{S}\right)\frac{N}{\sqrt{R}}} \sqrt{R \cdot S}$$

where

V = Mean velocity of flow, in feet per second;
N = Coefficient of roughness;
S = Sine of slope of hydraulic gradient;
R = Hydraulic radius of channel, or sectional area divided by wetted perimeter.

Following is a table of values of the coefficient N for various surfaces, as assigned by Kutter:

0.009 for well planed timber;
0.010 for neat cement;
0.011 for cement with one-third sand;
0.012 for unplaned timber;
0.013 for ashlar and brickwork;
0.015 for unclean surfaces in sewers and conduits;
0.017 for rubble masonry;
0.020 for canals in very firm gravel;
0.025 for canals and rivers free from stones and weeds;
0.030 for canals and rivers with some stones and weeds;
0.035 for canals and rivers in bad order.

The chart is made up of several parts. (1) A horizontal scale gives the sine of the slope of the hydraulic gradient, expressed as percentage. This scale is in the left section of the chart at the bottom; corresponding scales, just above and at the top, give the same function expressed in feet per thousand and feet per mile. The tangent of the slope may be used instead of the sine for slopes less than 2%. (2) A set of curves, nearly horizontal except at the extreme left, corresponds to several values of the coefficient N. These will be referred to as the Y-curves. (3) Another set, sloping steeply upward toward the right, corresponds to the same values of N as the Y-curves. These will be referred to as the Z-curves. (4) A set of curves in the right-hand section of the chart, convex to the right, corresponds to several values of hydraulic radius, R. (5) A set of parallel straight lines, sloping upward to the left, corresponds to several values of velocity, V. In addition there are vertical and horizontal guide lines. If a vertical line passes through the horizontal scale at the value of the slope and intersects, at the points Y and Z, respectively, the Y-curve and the Z-curve giving the value of N, then horizontal lines through Y and Z will intersect, respectively, the curve which gives R and the line which gives V, at points which lie on the same vertical line. In other words, any rectangle with a horizontal base, the left-hand corners of which lie on a Y-curve and a Z-curve giving the same value of N, connects simultaneous values of the four variables. The left side of the rectangle, produced, intersects the bottom scale at the value of the slope; the corners Y and Z give the value of N; the corner horizontally opposite Y gives the radius; and the corner opposite Z gives the velocity.

If any three of the variables be known, the fourth can be found by projection. Usually the unknown quantity is either the velocity or the radius. In such a case the procedure is obvious: the slope is taken first, the intersections Y and Z are then obtained, and a third corner is established according to the value of the known radius or velocity; the fourth corner of the rectangle then supplies the desired value. Visual interpolation between curves is used wherever necessary. Occasionally the unknown quantity is the slope, or the coefficient N; in either case, a value for the unknown is assumed; and the true value is then determined by trial, a process which is easily carried out.

Illustrations of the application of the chart in a few typical cases are appended.

RIVER DISCHARGE—To estimate the discharge of a river from measurements of cross-section and determination of slope; suppose that the width of section is 834 ft., that the mean depth as established by a number of soundings is 5.23 ft., and that the slope, determined by a line of levels running up and down stream, is 3.06 ft. in a distance of 4920 ft. Then the area is 4360 sq ft. The hydraulic radius may be taken equal to the mean depth, or 5.23 ft. The slope is 0.0622%. Assume N = 0.035 (for relatively high stages). To obtain mean velocity find the slope, 0.0622%, on the bottom scale, and project vertically to the intersection with the two curves of N = 0.035. From the intersection (Y) with the more nearly horizontal curve, project horizontally to a point between the curves R = 5 and R = 5.5, the eye being used to interpolate for R = 5.23. From the point thus determined, project vertically to a point horizontally opposite the intersection (Z)

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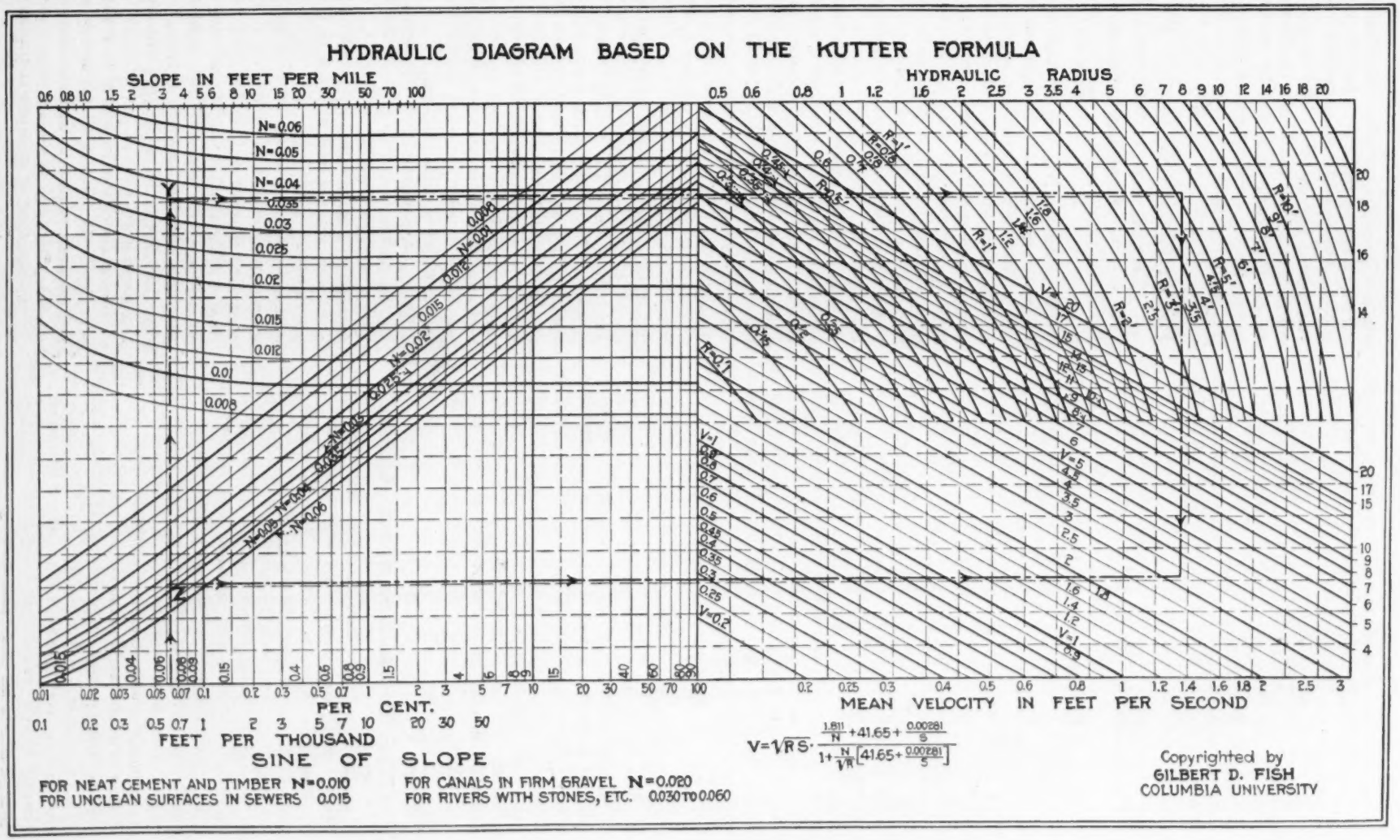
of the original vertical line with the steeply inclined curve of N. The point now established represents, by its position relative to the lines V = 3 and V = 3.5, the value of the mean velocity—3.28 ft. per sec. The foregoing operations on the chart are indicated by heavy lines with arrows, drawn for illustration. The discharge is now easily computed: Q = AV = 14,300 cu.ft. per sec.

DESIGN OF DITCH OR CANAL—To design the cross-section for a ditch to discharge 200 cu.ft. per sec., at a gradient of 2 ft. per mile, with a velocity not to exceed 2.5 ft. per sec.: assume N = 0.025; find on the top scale the slope, 2 ft. per mile, or, on the bottom scale, 0.0379%, and project vertically to the intersection with the two curves of N = 0.025. From the intersection with the Z curve, project horizontally to the intersection with the line of V = 2.5, and then vertically to a point horizontally opposite the intersection Y of the original vertical line with the nearly horizontal curve of N. The point thus established lies between the two curves, R = 3 and R = 3.5, in such position that interpolation by eye given R = 3.18. Now the area is required to be Q/V, or 200/2.5 = 80.0 sq.ft. If we conclude on a trapezoidal section with side slopes 1 : 1, we may call the bottom width B and the depth of water D. Then the area is D (B + D) = 80.0; and the wetted perimeter


HYDRAULIC DIAGRAM BASED ON THE KUTTER FORMULA
SLOPE IN FEET PER MILE
HYDRAULIC RADIUS
PER CENT.
FEET PER THOUSAND
SINE OF SLOPE
MEAN VELOCITY IN FEET PER SECOND
FOR NEAT CEMENT AND TIMBER N=0.010
FOR UNCLEAN SURFACES IN SEWERS 0.015
FOR CANALS IN FIRM GRAVEL N=0.020
FOR RIVERS WITH STONES, ETC. 0.030 TO 0.060
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COLUMBIA UNIVERSITY

is $B + 2D\sqrt{2} = 80.0 + 3.18$. Solving simultaneously for B and D, we obtain B = 11.06 and D = 4.98. Hence we may decide on a bottom width of 11 ft., and allow for a 5-ft. depth of water.

CAPACITY OF SEWER OR CONDUIT—To find the capacity of a circular brick sewer, 4 ft. in diameter, flowing full under a hydraulic gradient of 5 in 1000: assume N = 0.016; the hydraulic radius is one-fourth the diameter, or 1 ft.; the value of the mean velocity is found by using the chart in the same manner as in the first illustration. The arguments are: Slope, 0.5%; N, 0.016; R, 1.00 ft. It is necessary to interpolate for N between the curves N = 0.015 and N = 0.02. The velocity is found to be 6.56 ft. per sec The discharge, or maximum capacity of the sewer, is then Q = AV = 82.5 cu.ft. per sec.

Practical Formula for Switch Lead

Here is a plain formula by which can be figured the lead from the switch point to the actual (½-in.) point of the frog. The formula is devoid of sines, cosines and cotangents, but is easily close enough for practical purposes:

$$L = S + S\left(\frac{17N - 4W}{2S + N}\right) + W$$

In this formula S is the length of the switch-rail, point to heel, in feet; N is the frog number; and W the distance from the actual frog-point to toe of the frog, in feet. Switch points are assumed to be ¼ in. thick, and the rails at the heel of the switch to be 6¼ in. center to center; gage of track standard (4 ft. 8½ in.).

It does not seem necessary to give the derivation of this formula, but the result of its use may be seen from the following table of comparison:

N	S	W	A	B
6	11.0	3.79	47.98	48.65
8	16.5	5.08	67.98	68.14
10	16.5	6.42	77.93	78.30
16	33.0	8.66	137.57	137.18
20	33.0	10.50	157.42	157.84
24	33.0	12.33	177.22	176.84

In this table S and W are taken from the supplement of 1914 to the Manual of the American Railway Engineering Association, page 28, and column A gives the leads from switch point to actual frog point as figured from their formula and given on page 29 of this supplement. Column B gives the leads as found by the above formula, using the same data as to S and W. —CHAS. C. WENTWORTH, Prin. Ass't Eng'r, N. & W. Ry., Roanoke, Va.

The Truss Problem Again

On the truss-web problem of Prof. E. Marburg (p. 490, Mar. 11 issue) some further comments are at hand. A. W. Bedell, Santa Fé, N. M., under date of Mar. 22 proposes solutions which are the same as those already shown in Fig. 3 (p. 592, Mar. 25 issue). G. L. Bilderbeck, New London, Conn., comments on the solutions given in the issue of Mar. 25 and objects to those which do not give a perfect triangle network. Thus, in C. H. Moorman's solution he criticizes the left-hand sketch as showing a trussed beam with one support inclined, instead of a triangular truss; and the right-hand sketch because it shows a quadrilateral in the web. In E. Godfrey's solution he makes similar objection to the right-hand sketch (Case 2, tension in bottom chord). Mr. Bilderbeck's suggestion for solving Case 2 is a radial web of four members, running from a central point to the three vertices of the triangle and to the load—thus showing a combination of the two sketches of Fig. 1. The stresses in such a truss would be statically indeterminate, of course.

Prof. Marburg expresses a decided preference for the solution Fig. 2. He considers that the trussed-beam arrangement represented by both sketches of Fig. 1 does not fairly meet the requirement for a web system. He regards it as more than doubtful whether the internal members in Fig. 1 are anything more than chord members of subsidiary trusses.

Methods and Costs of Moving Earth in Southern Road Construction

BY N. C. HUGHES, JR.*

All cost data in this article are based upon the total expense of operating and maintaining an efficient grading outfit; also upon the basis of a county- or township-owned and operated outfit. It is undoubtedly cheaper, under proper management, to handle earth with such an equipment than by contract. Cost data are based upon labor, graded from $3.50 for the foreman to a dollar a day for a waterboy, together with interest on capital invested, allowance for monthly deterioration of equipment and all current expenses.

Under conditions where there is an average excavation per mile of about 2000 cu.yd., with material varying in classification from loose rock to sandy loam, so balanced so as to give 500 ft. average haul from cut to fill, and not over 200 ft. haul for waste, I should say the most economical method of moving earth is by means of teams and wheelers.

The cost of earthwork by wheelers is based on what the snatch-team can move per day or per month, preferably per month. Efficiency requires enough wheeler teams on the job to keep the snatch-team busy loading one wheeler and turning almost immediately to load another, whether it requires five or ten wheelers and teams. The longer the haul, the more teams, of course, are required. About one team is necessary to every additional 100 ft. beyond a 500-ft. haul and up to a 1000-ft. haul. Five wheeler teams are ordinarily sufficient to handle a 500-ft. haul with ease. Where the excavation is continuous it is always economical to equip the outfit with a first-class team as well as with first-class machinery.

The cheapest method of moving earth is by means of a four-up snatch-team loading No. 3 size wheelers, which have a carrying capacity of 17 cu.ft. This outfit will move on an average from 8500 to 9000 cu.yd. per month of 24 working days each, at a cost of from 14c. to 15c. per cu.yd.

It is possible to move earth quite cheaply with a three-up snatch-team also, loading wheelers of No. 2 size having a carrying capacity of from 12 to 13 cu.ft. each. But since it is obvious that the four-up team will move upon an average a third more earth than a three-up team, with only little additional monthly expense, the conclusion is that it is cheaper to be equipped with the heavier team and larger wheeler.

No doubt the excessive cost of excavation in road construction is often due in a large degree to lack of proper and efficient equipment. To be lacking one or two teams

*Superintendent of Highways of Halifax County, Weldon, N. C.

for the rapid handling of earth is a great deal more expensive than the overhead expense of carrying one or two extra teams for the purpose of running them in when needed.

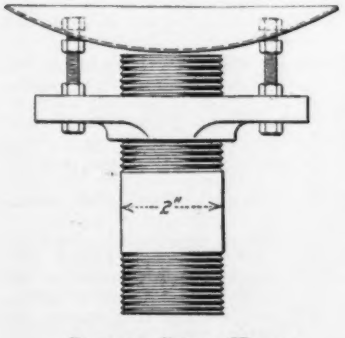
There are conditions where it is very economical to move earth with the ordinary drag scraper of from 5 to 7 cu.ft. capacity, or with a fresno or buck scraper carrying 8 to 10 cu.ft. But the work must be either a swap-over proposition or not have a haul of more than 250 ft.; and in addition the material to be moved should be rather light. Work of this character with either of these scrapers should easily be done for from 6c. to 8c. per cu.yd. Upon the whole, however, these tools are merely adjuncts to the whole equipment and in no way substitutes for the wheeler.

Where it is necessary to remove rapidly the top of an old, worn road to a depth of 4 or 5 in. (to be replaced with a good surfacing material), provided the location and conditions will at all permit, the cheapest method is with a six- or eight-horse road machine or grader. By this method, however, the material can be removed only to either side of the road. Under ordinary conditions this class of earthwork may be done for about 5c. per cu.yd.

The road machine also does very economical work in cutting off the bumps and filling in the holes in the preparation of the subgrades for the surfacing material. In some instances also it can be used economically in hillside or mountainside cuts which are either halfway or two-thirds work. Earth can be moved by this method for 5c. or 6c. per cu.yd. under normal conditions. In this work, too, the fresno or buck scraper will, for short hauls or swap-overs, give very economical service, moving earth at from 8c. to 9c. per cu.yd.

New Sprinkler System for Coal Breakers

Sprinkler systems which can be turned on by hand from outside the building have been installed in 14 of the wooden anthracite-breakers of the Lehigh Valley Coal Co., Wilkes-Barre, Penn. Tests of these systems before a committee of the Underwriters' Association of Pennsylvania have resulted in a substantial reduction in the high rate of coal-breaker insurance now in force, for breakers thus equipped.



SPECIAL SPRAY-HEAD

The new sprinkler system consists of pipes spaced 10 or 15 ft. apart and equipped with nozzles, pointing upward, which dash water against convex or flat metal plates fastened to the feed pipes as shown. The water is thus diffused. About one hundred 2-in. nozzles are required to protect a large breaker. The nozzles are fed by 2-in. pipes, leading from various sizes of water mains.

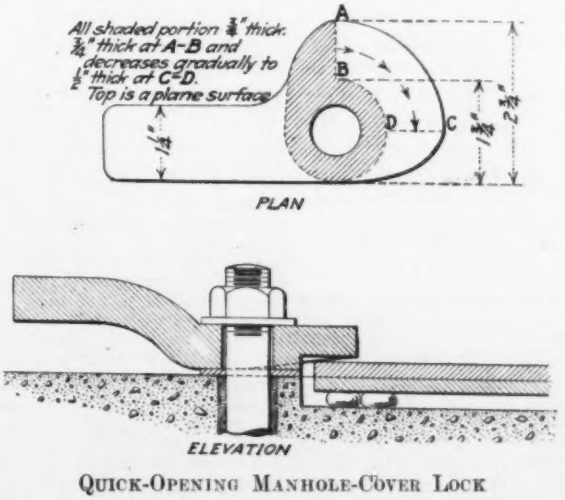
The new system supplements but does not replace, the regular fire-fighting apparatus installed in every breaker, such as hose, standpipes, fire-pails, sand-pails, water-barrels and hand-grenades. When the system is operated, the interior is filled with a steady downpour of water, similar to a heavy rainstorm. At such a time, it is possible for men to enter the structure and attack the fire with the regular fire-fighting apparatus, the spray system being independent of the regular apparatus. Without such a system, it is almost impossible to enter a breaker which has caught fire; the conflagration is quick and hot, due to the numerous drafts throughout the immense structure

NOTES

Measuring a Bridge Span with 1050-Ft. Tape is the method used at the Hell Gate arch bridge, New York, to check up the distance from abutment to abutment prior to steel erection. The span of the large arch is 977½ ft. between centers of end pins (see "Engineering News," Jan. 8, 1914). The concrete towers over the abutments rise at present to roadway level, 145 ft. above water. A wire has been strung across from tower to tower, and to take a measurement the tape is hauled across by fastening it to the end of the wire. The tape is $\frac{1}{32}$ in. thick by $\frac{3}{4}$ in. wide, and its end marks have been checked by Keuffel & Esser at a standard pull. The tape hangs free between end supports for a measurement, the standard pull (about 71 lb.) being applied by spring balance fastened to a turnbuckle rod. Departure of temperature from standard is corrected for. The tape measurements have given a very satisfactory check on the pier locations, which had been fixed by triangulation.

Prizes for Articles on "Thermit" Welding or the various carbon-free metals and alloys produced by "Thermit" processes have been offered by the editor of "Reactions," the house organ of the Goldschmidt Thermit Co., 90 West St., New York City. The prizes will be $30, $20 and $10, and the contest will close Dec. 10, 1915. The criteria will be originality of subject-matter and method of presentation.

Air-Tight Manhole Covers In a Sewage-Disposal Plant—Slow-opening and quick-opening steel-plate air-tight manhole covers have been provided for the sewage-works of Calvert, Tex., after designs by Thos. L. Fountain, of College Station, Tex., engineer for the works. The slow-opening covers are over settling-tank manholes not often used and are of $\frac{3}{16}$-in. plate, bolted to a 5-in. concrete roof which extends over the whole space, 12 bolts (⅝-in.) being used for a 32-in. cover over a 24-in. opening and 10 bolts for a 26-in. cover of an 18-in. opening. The quick-opening cover, over the screen chamber, is of ½-in. plate, 28 in. in diameter to cover a 24-in. opening, and is hinged. The cover is fastened by means of four button-wedges, as shown by the accompanying details. To secure tightness, rope packing is placed beneath the edge of each cover of both the slow-opening and the quick-opening kinds



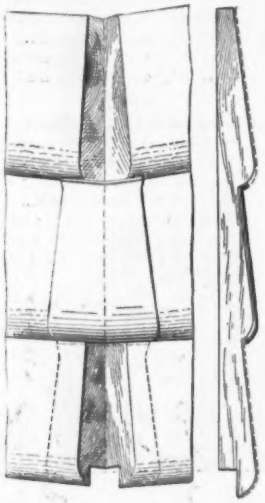
QUICK-OPENING MANHOLE-COVER LOCK

A Concrete Road Severely Handled—The accompanying view shows a part of the Henderson Road near Evansville, Ind., after being subjected to a recent severe flood from an overflow of the near-by Ohio River. The road at this point consists of 1300 ft. of 15-ft. reinforced-concrete pavement laid

15x30-Ft. Pavement Slabs Displaced by Flood

with expansion joints every 30 ft. In this stretch one slab (as shown) was uprooted cleanly from its foundation and carried about 30 ft. with no apparent damage, while seven other slabs, more or less displaced, are only slightly cracked.

Metal Corner Cap for Rustic Siding—A simple pressed-steel corner cap for rustic siding has recently been marketed by C. B. Howard, of Santa Rosa, Calif., and is finding much local favor with builders who desire to eliminate the trouble and expense of mitering rustic corners. The scheme is shown in the accompanying sketch. Each cap overlaps the one below and gives a tight joint; the caps are inexpensive and are quickly nailed on.—O. H. Bailey, Santa Rosa, Calif.



Steel Corner for Rustic Siding

A Street Traffic Signal with Whistle, invented by B. M. Harris, of San Francisco, is used in that city to direct the flow of vehicles at congested points. A large double-pointed arrow bearing the word "Stop" on both faces is suspended above the street junction, with a frame and small motor to turn the sign in 90-deg. jumps. The motor also blows a whistle—one blast for traffic in one direction and two blasts for the other. At nigh the sign is lighted by two 30 cp. lamps. When not in use shutters cover the sign. When the crossing is to be cleared for fire apparatus the whistle blows and the arrow revolves continuously. At night this alarm is accompanied by the lighting of a lamp in a red globe below the arrow. The signal is operated from the traffic officer's stand.

Precise Leveling of Prussian Government Land Survey—Some interesting changes in the methods of precise leveling have been made in recent years by the Prussian Government Land Survey. For the daily determination of the length of the rods, they were laid upon a bed of wadding instead of upon the ordinary supports. To compensate for the inequality of differential refraction for back- and fore-sights the precaution was taken to have no shot come within 25 cm. of the ground at a length of sight of 25 m., and within 50 cm. for shots longer than 25 m. When the rods were not in use they were stored in a place exposed to the air. Thus, much greater uniformity in length has been secured. The rods were put upon a fairly level and horizontal table of 3 m. length in the open air, under a shelter giving sufficient protection against rain and sun. All rods were compared on this table. In finding the length the number of single observations was increased from 8 to 16, with the result that a better mean value was secured. It was proved that rods which had been stored in a house four weeks, and thus had dried out, expanded constantly in fieldwork. Those which were continually kept in the open air, however, showed scarcely any measurable changes during the time they were used in surveying.—H. G. Habermehl, of Keuffel & Esser Co., Hoboken, N. J.

Experience in Ditching with Dynamite has been reported by C. A. Edwards, Civil Engineer and Superintendent of Irrigation at Gothenburg, Neb. He had several ditches badly filled up with muck which it was found would cost upward of 50c. per cu.yd. to dig out, since the ground around the ditches was soft even for a man to walk on. Therefore when a good wind was blowing, half-pound sticks of dynamite were placed 28 in. apart each way along the ditch, sometimes in two rows and sometimes in three. Some 20 sticks were shot at once, using electric fuses and a firing machine with 300 ft. of cable. The holes for the dynamite were made with a 1-in. gaspipe and were 3½ to 4 ft. deep, always going down to sand and in 2 ft. of water. These holes were put down

Irrigation Channel Widened by Dynamiting

45° from the perpendicular, and as soon as the gaspipe was removed a cartridge was placed in the hole and rammed home with a wooden rod. The hole was closed with the foot, leaving the fuse wire extending. Water was depended on for tamping.

Where there was a good sand foundation and water for tamping, the mud was removed at a cost of 18 to 20c. per cu.yd. Where there was no sand or water, the method was practically a failure.

A Fire Test of Tile Partitions has been made by R. W. Hunt & Co. at the Chicago plant of the National Fireproofing Co. A structure 10x12 ft. and 12 ft. high was built about a year ago, having 4-in. tile walls and two tile partitions (one 8 in. and the other 4 in. thick), plastered on both sides. The tile blocks were laid with the hollow spaces vertical, and on top of each course was a line of horizontal channel tile containing steel reinforcing bars in concrete. The mortar joints were about ⅜ in. thick.

The fire test followed as closely as possible the requirements of the American Society for Testing Materials. In the furnace beneath the central compartment of the structure a temperature of 1688° F. was raised in 48 min., after which it averaged from 1716 to 1903°, and reached a maximum of about 2000° during a period of 2 hr. 18 min. Water at 30-lb. nozzle pressure from a fire hose was then applied to the inner surface of the partitions for 3 min. from an opening in the end wall, and then for 2½ min. through an opening in the roof. The 1⅛-in. nozzle was about 6 to 12 ft. from the partitions.

About 45 min. after the test started, hair-cracks began to appear in the plaster on the exterior of the partitions. These were due to vertical expansion, and finally appeared opposite practically all of the horizontal mortar joints. No other defects appeared on the exterior. A very small amount of moisture was observed on the plaster surfaces near the end of the test. After cooling it was found that about 60% of the internal surfaces had been stripped of plaster by the water. About 25% of the tile exposed showed fine hair-cracks and checks, and a small amount of the dovetails had been broken from a few tile.

Editorials

An Expensive Cutoff Wall

If the cutoff wall proposed for the ill-fated Cedar Lake Dam at Seattle is to be built as noted in the communication from C. E. Fowler in the news pages of this issue, it will surely go down in engineering history as the most expensive repair job on record. A million and a half dollars to stop leakage through a porous formation against which the designers and builders were repeatedly warned would in itself be sufficient to make the dam notorious; the construction of a tight wall in a long sheeted trench only a few feet wide and over two hundred feet deep should make it famous.

What Does It Cost to Stop and Start a Railway Train?

The question what it costs a railway company to stop and start a train is one of considerable practical importance. There are constant appeals from towns and cities that express trains make additional stops. In states where laws require railway trains to come to a stop before passing over a grade-crossing not protected by interlocking signals and derailing switches, a comparison may be made between the cost of the interlocking plant and the saving made by running a large proportion of trains through without stopping, when the cost of stopping a train is determined.

F. W. Green, General Manager of the Louisiana & Arkansas Ry., reports the results of an investigation into the cost of stopping and starting trains in the March *Bulletin* of the American Railway Engineering Association. After deducing an extended formula for computing the cost of stopping and starting trains under any given set of conditions, Mr. Green gives an example of the application of his formula. He finds that the stopping of a freight train weighing 2000 tons from a speed of 25 miles an hour and accelerating it to the same speed on level track, using fuel at $3 per ton, costs the railway company 61 cents. Nearly half of this expense is accounted for in the coal required by the locomotive to get the train under way again. The time lost by the train-crew owing to the stop is estimated at 10 cents and the wear and tear on the brake and draft rigging, etc., at 20 cents.

It is probable that this is an underestimate rather than an overestimate of the cost of stopping trains. The lost time will generally average more than the 2½ minutes which Mr. Green allows, and there is always a chance that more or less delay will occur in starting the train again if the stop is made where grades or curves are unfavorable. Stops of light passenger trains are comparatively inexpensive, but stops of heavy express trains would probably be considerably more expensive than the 61 cents given, for the lighter tonnage would be more than offset by the greater amount of energy which has to be put into the higher-speed train after a stop, the stored energy of course varying as the square of the velocity. On a road with heavy traffic, where trains follow one another closely, the introduction of an unusual stop may cost several times the figure suggested, since the stopping of one train may cause the stopping of a number of trains following.

A Discord in the Demands for Industrial Education

Have our American educators too readily accepted the arguments of enthusiasts for industrial courses and public vocational schools? We have been told, for instance, that nine children out of ten in our public schools eventually pursue manual instead of mental occupations. There has been no end of "statistics" quoted to show that the majority of our future citizens were receiving an education not at all fitting them for their future—work at some sort of manual labor. Two documents now at hand furnish uptodate figures on this subject: A report of the U. S. Commission on Vocational Education and the "Survey of Boys and Parents in City Schools," by L. P. Ayers, of the Russell Sage Foundation.

The statistics of the U. S. Commission show that some 75% of the five million children of the age of compulsory school attendance are in school, and that 10% leave at 13 years of age, 40% at 14 years, 75% at 15, and 85% at 16.

It has often been claimed that children left school at an early age because of the lack of industrial and vocational courses to hold them there, but Dr. Ayers' figures do not seem to support this. His studies covered all the American cities of 25,000 to 200,000 population (except suburban districts), and sought facts about the 13-year-old boys who had reached the end of their compulsory-attendance stage and about their fathers.

There were 22,027 boys in 78 cities, and they were scattered through all grades from kindergarten to the end of high school. Half were below the seventh grade; in a few cities where particular thought is given to this problem eight out of ten boys were in the seventh grade and above, compared with one in ten for other places. Only one father in six was born in the city in which he now lives, and only one-half of the boys were born there. Moreover, only about half the fathers were engaged in building trades and manufacturing industries, while more were engaged in the professions than in unskilled labor. More than one-third of all the parents were mental workers.

All of these figures have a bearing on the sort of life-work we may expect these school boys to follow, and should influence the development of educational systems. One of the great demands of industrial-education enthusiasts has been that the schools should shape their courses to fit the children to enter local industries. But evidently only a few of those now in school are likely to live in the city of their birth. Moreover, manual occupations for which special training is urged will engage only

perhaps half of the boys. It might be added, too, that the development of automatic machinery has to some extent destroyed the arguments of those who claim that the factory worker should be taught a trade in the schools.

The obvious lesson from these figures is that industrial education, important and valuable as it must be conceded to be, should not be permitted to usurp an undue place in the educational system. It is more important that the boys who end their school life at 13 or 14 should receive education in the real meaning of that word than that they should acquire a little knowledge or skill in certain industrial processes. The great object of the schools is to educate future citizens, and no claims of any special training should be allowed to interfere with that object.

Average Draft of Ocean Vessels

So much has been published concerning the huge ocean steamers built for Atlantic passenger travel that many people suppose these vessels to be typical of present day ocean carriers. In the Congressional debates on River and Harbor appropriations, for example, appeals are constantly being made for deepening harbor entrances on account of the large size of present-day ocean vessels.

But as everyone familiar with the shipping business knows, the ocean freight business is nearly all done in vessels of moderate size and draft. The table herewith is reprinted from a paper by Major E. J. Dent, Corps of Engineers, U. S. A., published in the "Professional Memoirs" of the Corps. It shows the actual draft of all vessels which paid pilot dues at the port of New York from Jan. 1 to June 30, 1914. This includes all foreign vessels, all American vessels arriving from foreign ports, and all vessels sailing under registry to and from New York. Most coastwise vessels use their own masters or mates as pilots and so are not included.

It should be noted in addition that New York has a larger number of vessels of enormous size and very deep draft entering and leaving it than any other seaport in the world. Similar figures for any other port of America or Europe, therefore, would show a much smaller proportion of deep-draft vessels.

So much has been said and written to the effect that every increase in depth of a navigable channel reduces the cost of traffic through it, that many suppose it has the force of a universal law. This is far from being the case. The United States has been so lavish in its expenditure on river and harbor improvements that the available depth in its principal commercial harbors is greater than in the principal ports of Europe.

In building vessels for ocean traffic, with the exception of a very few high-class passenger liners, the ship owner must consider the available draft in the chief ports of the world and not those of any particular country. It is, therefore, of no advantage to the United States or to its commercial ports to deepen their harbor entrances beyond those of the chief ports of Europe.

It will be seen from the table that even at the port of New York, frequented as it is by the largest ships, 96% of the vessels entering and leaving the port draw less than 30 ft. of water, 89% of the vessels draw less than 28 ft. and 75% less than 25 ft. Of course, a certain margin of depth is desirable to allow for inequalities in the bottom, for movement of the vessel by wave action and for the "squat" of the ship when in motion. On the other hand, harbor-channel depths are commonly referred to low tide. It is no serious hardship if an occasional vessel of exceptional draft has to wait for the tide to cross the bar; in fact, large vessels entering some of the largest ports of Europe are obliged to do this.

DRAFT OF VESSELS PAYING PILOT DUES AT THE PORT OF NEW YORK, JAN. 1 TO JUNE 30, 1914

Drafts Between	Number of Vessels	Total No. of Vessels of Deeper Draft	Accumulative Per Cent. of Total
38 and 39 ft.	3	3	0.0655
37 and 38	5	8	0.1749
36 and 37	7	15	0.3277
35 and 36	13	28	0.6118
34 and 35	7	35	0.765
33 and 34	18	53	1.158
32 and 33	41	94	2.054
31 and 32	41	135	2.95
30 and 31	39	174	3.802
29 and 30	68	242	5.302
28 and 29	167	409	8.937
27 and 28	133	542	11.844
26 and 27	169	711	15.537
25 and 26	231	942	20.585
24 and 25	239	1181	25.808
23 and 24	287	1468	32.08
22 and 23	353	1821	39.794
21 and 22	340	2161	47.224
20 and 21	295	2456	53.671
19 and 20	318	2774	60.62
18 and 19	335	3109	67.941
17 and 18	268	3377	73.798
16 and 17	177	3554	77.666
15 and 16	211	3765	82.27
14 and 15	234	3999	87.39
13 and 14	182	4181	91.368
12 and 13	164	4345	94.951
11 and 12	123	4468	97.639
10 and 11	92	4560	99.65
9 and 10	14	4574	99.956
8 and 9	2	4576	100.
Total	4576		

It would appear from this table that aside from the port of New York, with its few exceptional large vessels, an available channel depth of 30 ft. will accommodate practically all ocean freight carriers of the present day.

Cost of Highway Maintenance in New York

The New York Legislature has appropriated $4,100,000 for the repair and maintenance of the state highways during the coming fiscal year. There was strong opposition to the appropriation on the ground that so large an amount was unnecessary. Mayor Mitchel of New York City filed a request for a hearing on the bill, and the City Club of New York has sent an appeal to the legislature to have the appropriation cut down.

It is not strange that there should be opposition to this appropriation, for the public generally does not yet understand how great a burden it has assumed in connection with the building of improved highways. A few figures, however, will enable any engineer to judge for himself as to whether the appropriation of $4,100,000 for a year's maintenance of New York's state highways is excessive.

The state has thus far expended about $65,000,000 in the construction of about 6300 miles of improved roads. Of this $65,000,000, it may be assumed that a little less than half has been expended on what may be termed the permanent features of the roads, such as grading, bridges, culverts, drainage and foundation courses. It is safe to assume therefore that about $35,000,000 has been expended by the state in the construction of the wearing surface of these 6300 miles of road. This wearing surface has a limited life. Experience not only in New York but in many other states has fully proved that unless this wearing surface is maintained in good condition year by year it will very soon be wholly destroyed and require entire renewal. Unfortunately, this is exactly what has

happened to a good many miles of New York's state highways. Previous legislatures have pursued the unwise economy of cutting down the appropriations for highway maintenance, thereby making it impossible to take the stitch in time that saves nine. It is agreed by all parties that on a very large mileage of the New York state highways expensive resurfacing work is necessary in order to save what is left of the wearing surface.

Dividing the total sum appropriated for maintenance, $4,100,000, by the mileage of New York state roads, assumed at 6300, we have an average of $650 per mile. Massachusetts, which has steadily pursued the policy of repairing its roads as fast as they become worn and of not allowing them to deteriorate, finds it necessary to expend $450 to $500 per mile annually for maintenance. It is evident, therefore, that New York needs to expend a greater sum. Its state roads are not as well planned or as well built as those of Massachusetts, and they have suffered far more from neglect since they were constructed.

It cannot be assumed, either, that this is an extraordinary expenditure for this year only and that smaller appropriations for maintenance will suffice in future years. The state still has some $35,000,000 of its second $50,000,000 bond issue to expend on good-road construction; and even this, it is stated, will fall a long way short of completing the entire system of good roads that has been laid out.

The present year's appropriation is about one-eighth of the total expenditure that the state has thus far made on the surfaces of its improved roads. In other words, it may be said that this appropriation assumes an average life of the surface of an improved road of eight years before it requires complete renewal. If, however, any of these roads were entirely neglected and no work was done upon it in the way of repair and maintenance, it would be destroyed in a much shorter time than eight years.

In computing the cost of maintenance of a roadway surface, there must first be considered the average amount which it is necessary to expend in annual repairs to keep it in fair condition, and second, what must eventually be expended upon it after the lapse of years, when the surface becomes so worn that it must be entirely renewed. The experience thus far accumulated with various types of bituminous-macadam roads under such heavy traffic as most state highways are receiving proves that to keep them in good condition at least 10 per cent. per annum of the original investment in the road surface must be expended. If we assume that of $100,000,000 to be invested in New York's state road system $60,000,000 will be expended upon the surface, the state must look forward to an annual bill for state highway maintenance of not less than $6,000,000.

Is the Independent Consulting Engineer to Become Extinct?

It has been stated by prominent members of the legal profession that were it not for statutes which forbid corporations from engaging in the practice of law, the legal business of the country would rapidly gravitate into the hands of corporations. The lawyer now having an independent practice would be obliged to accept service as an employee with such a corporation, or abandon his profession.

If this is the case in the profession of law, where personality cuts so large a figure in the service rendered, how much greater is the tendency in the engineering profession for important business to gravitate into the hands of the strong corporation with a complete organization and equipment? An illustration of this tendency has just occurred in New York. The Public Service Commission of New York City has in its service a large staff of engineers, including a number of men recognized as leaders in their profession. In the construction of the new subway lines, the system of ventilation which has been planned, as described in one of the series of articles by F. Lavis in our issue of Nov. 5 last, provides for the discharge of the air from the subway through open gratings of large area in the street sidewalk. Objections to these gratings have been made by adjacent property owners, and it has been urged that ventilating shafts should be constructed, either on private property alongside the subway or in parks or public squares. Through these shafts the air discharged from the subway would be delivered above the sidewalk level. Under these circumstances the commission has voted to employ the firm of J. G. White & Co. as consulting engineers, to work with the commission's own engineering department in perfecting a system of ventilation for the new subway different from delivery through the sidewalk gratings.

The question may fairly be raised whether this matter was one justifying the employment of an independent consulting engineer. There is no reason to doubt that the commission's own engineering staff is perfectly competent to design a ventilating system to discharge the air either at the sidewalk level or wherever else it may be deemed best. The real problem to be solved is not engineering difficulties in the design of a ventilation system, but it is the question which so often comes up in connection with construction work—"What is worth while?" In other words, are the objections, real, fancied or sentimental, to the gratings in the sidewalk sufficiently important to justify the additional expense that will be necessary if uptake shafts are built on private property to discharge the subway air? No doubt the commission's own staff could prepare plans and submit comparative costs of the two types of installation, from which the commission itself, if it is made up of men of the proper caliber, should be able to reach an intelligent decision.

Notwithstanding this, the commission may be justified in seeking the advice of an independent consulting engineer. Simple though the problem may seem to an engineer, it doubtless appears like a very complicated one to the layman. It may well be, also, that the commission thinks it worth while to fortify its decision by obtaining the opinion of prominent engineers entirely outside its own organization.

Assuming this to be the case, why should such an organization as that of J. G. White & Co. be chosen instead of an independent consulting engineer? Admittedly, the corporation named has a high reputation for the work it has accomplished in the field of electric-railway construction and management, as well as in other important lines of engineering work. Its reputation, however, has been gained in the field of contract work, construction and operation. Its organization is arranged with a special view to this class of work. It has on its staff of engineers men of great ability, but are these men particularly

expert in the field of work in which this special problem lies?

It is altogether probable that the company was consulted in the present case simply on its general reputation and not because any of the men in its organization were known to be experts in the field of ventilation.

It is on this question, it seems to us, that the issue will turn as to whether the corporation is to supersede the independent engineer—the question whether the individual engineer can gain prestige enough and reputation enough so that big clients desiring advice in his field will seek him instead of going to some well-advertised corporation which is supposed by the public to command ability in every field of engineering.

In the field of sewerage and water-supply, for example, there is a considerable number of engineers of such wide reputation that they would certainly be employed by a client having a case of great importance in preference to any impersonal engineering corporation. Had there been an engineer of great reputation in the field of ventilation, he might have been selected by the Public Service Commission in place of the corporation for the work under discussion.

How, then, can the engineer add to his knowledge and ability the wide reputation that will make clients seek him for important work in preference to the big corporation which is widely known for its accomplishments and financial standing? This is the problem which the engineering profession must solve if the independent consulting engineer is to continue to be an important factor in professional work.

We believe that even the eminent members of the profession who hold responsible positions in the great engineering corporations will agree that the independent consulting engineer ought to be preserved; that consolidation has its disadvantages as well as its advantages; and that the profession needs to develop men of strong individuality, who can be leaders in thought and action, as well as employees.

We shall not attempt here to answer the questions we have asked above. We may suggest, however, that the public ought to understand better the character of service that a consulting engineer can render, and that this service will actually be individual service, whether it is rendered by an independent engineer or by an engineer in the employ of a corporation.

Letters to the Editor

A Federation of the Engineering Societies of Philadelphia

Sir—I want heartily to indorse the editorial in the Apr. 1 issue of ENGINEERING NEWS entitled, "The Local Engineering Society Again to the Front," and in this connection I wish to call your attention to a forward step which the engineers of Philadelphia are making to bring about coöperation among all engineering activities in our city.

The inclosed copy of the final amendments which have been adopted for the by-laws of the Engineers' Club, whereby local sections of national societies affiliate in a broad coöperative plan, seems to a great many Philadelphia engineers to meet in a satisfactory manner a real problem in our city.

D. ROBERT YARNALL.

Chestnut Hill, Philadelphia, Penn., Apr. 6, 1915.

[The new by-laws of the Engineers' Club of Philadelphia adopted on Mar. 20 provide a new class of affiliated members, those who hold membership in a society which may become affiliated with the club. The plan has been worked out in much detail; and any local engineering society which is trying to solve the problem of effective coöperation with other societies would do well to obtain from the club a copy of the new by-laws.—EDITOR.]

Wind Reactions of Mill-Building Bents

Sir—Your issue of Mar. 25, 1915, contains an article by C. L. Christensen entitled, "Waste of Metal in Mill-Building Columns." The article states that the usual assumption of equal reactions at the base of the columns on the leeward and windward sides of a building gives column stresses far in excess of the actual stresses.

The writer made no attempt to follow out the calculations leading to this claim, as he could not agree with the assumption that the force exerted on a building is all on the windward side. It looks reasonable that a partial vacuum would be formed on the leeward side of a building that would exert a suction on the leeward side. The best experiments that the writer remembers on wind pressures on buildings tend to show that the total wind force is exerted in a pressure on the windward side and a suction on the leeward side approximately in the proportion of 55% and 45% respectively.

The writer believes that the usual assumption of equal reactions at the base of the two columns gives results more nearly correct than the recommendations in the article referred to.

W. L. SIX.

Kansas City, Mo., Mar. 30, 1915.

Progress Toward Wiser Railway Regulation

Sir—I have read with much interest in your issue of Mar. 4, p. 450, your editorial on "Progress Toward Wiser Railroad Regulation." I note in it how frankly the railroad presidents named acknowledge the stubborn and stupid attitude once too prevalent among railroad managers. That they have reached a more enlightened stage is a welcome announcement. Mr. Atterbury suggests that no step could be taken by the business men of the country more fruitful of practical benefit than to insure that any man appointed to regulate our railroads should be qualified by railroad experience. I do not agree with Mr. Atter-

bury. The operation of railroads is now largely a matter of routine work, signing reports, etc., as prepared for the different heads of departments. There is no doubt that expert engineers who are able to judge on all important matters as well as the railway officials can be found outside of railway circles.

It is new blood the railroads need in order to be more hospitable to new ideas and improvements in methods and appliances, which will benefit the railway stockholders as well as the public. I speak from 45 years' experience as an engineer, as well as a railway stockholder.

WILLIAM H. WOOD.

Media, Penn., Mar. 8, 1915.

Competition by Professors in Engineering Schools

Sir—While I am neither a professor nor a consulting civil engineer, I think that the articles appearing on this subject are rather one-sided. I am of the opinion that, all things considered, the engineering profession is not very much hurt by the fact that some college professors do outside engineering work. If these gentlemen were to give up their college work and devote their entire time to outside engineering, their competitors would have less work to do than under the present system.

It is painful to acknowledge, but nevertheless a fact, that quite a number of our colleges pay professors in the engineering departments salaries more in line with what a common laborer receives than with a decent salary for a professional man. Some of these engineering professors could double—yes, increase five times—the salaries they get from colleges by going into private work. Some, I grant you, are not worth the salary they are getting; but these are not the men that cause the complaint from engineers by being retained in their stead.

While some of these poorly paid professors would no doubt stick to their colleges from a sense of duty, or a lack of sense, there would be quite a number who would give up the college with its small salary for the broader field of competitive private work should the issue be made one of necessary choice. Then, lacking competent instruction in our schools, who would lose and who gain? Would the other engineers gain anything by having more and keener competition? Would these engineers get more work than at present? I doubt it.

A WATER-WORKS MAN.

South Carolina, Apr. 3, 1915.

[It seems fair to say that what "outside engineers" have complained of is not so much competition as competition on unequal terms. If the college professor charges as high fees as the independent engineer is obliged to in order to pay his expenses and render good service, a large part of the cause for complaint will be removed.—EDITOR.]

How Professor-and-Student Competition Made an Engineer a Contractor

Sir—The tale I am to tell about the Triangle Engineering & Construction Co. has to do with competition between college professors in engineering schools and engineers in private practice. The sequel of the story is found in the "Construction" part of the name of the company. Mr. X., the general manager and business getter of the company, has all the earmarks of a wide-awake, aggressive man, and boasts quite an extended experience in engineering and construction work in both this and other countries, besides a good education. After service abroad he came back to this country in the employ of an electrical construction company building an interurban railway through Squareville. Mr. X. decided there was an opening in Squareville for the establishment of an engineering company specializing in power plants, transmission lines and electric railways. So engineering offices were opened on completion of his engagement with the construction company. I said he was aggressive. So he hunted business, just as all engineers do who survive in private practice.

In the course of time the town of Circleville built a municipal plant that cost $50,000. Now Mr. X. had this job about secured, with its 6% fee, when a professor of Blank University (a private institution) looking for practical experience for his students—some of whom would be in Mr. X.'s shoes a few years hence—offered the town of Circleville all necessary engineering services in the planning and construction of the plant for the cost of drafting material, etc., only, and necessary expenses incurred on the job. It was not competition—it was monopoly of the stranglehold variety that the professor was able to apply.

Of course there are two sides to this story. For instance, the town saved $3000—perhaps—maybe more, one cannot tell. At any rate, there was a very small bill for engineering. The students, however many participated in the work, were probably better equipped at graduation than they would have been if their education had been confined to the laboratory and to visiting plants in operation. But that is an open question.

Mr. X.'s other experience was of a similar nature. A preliminary report was to be made on cost, etc., of a municipal plant. Such a report would entail a fee of from $500 to $1000. Mr. X. had given some time to cultivating the business and had reason to expect an engagement, when a professor from State University offered to make the report for much less, and got the job. In this instance it might be called competition, for, as I understand it, the professor was interested in the fee. He had the advantage of a fair salary paid him by State University and the name of the great university to trade upon. The report was preliminary to a popular election for issuing $750,000 bonds, which failed to carry. If the bonds had been approved by the people there were visions of a fee (6% on $750,000) for the private engineer and some less figure for the professor, depending upon how much he could utilize student labor and state plant.

Here is where the sequel "Construction" begins to develop. The Triangle Engineering & Construction Co. determined not to spend its energy hunting engineering work, but to enter the contracting field and to accept and do such engineering work as was offered it.

When Mr. X. decided to do miscellaneous contracting, he had in his employ a young electrical and a young mechanical engineer, recent graduates of engineering schools. After having two jobs taken from him by university professors he did not have enough straight engineering work to keep them. Either he must make use of them in his contracting work or let them go and be put to the inconvenience of hiring new special engineers as the needs

of his engineering work required. He decided to train his men in the contracting end of the firm. Now that consisted largely of what is ordinarily the civil engineer's work, such as taking off quantities for making proposals, and his men were electrical and mechanical. So he held school, so to speak, devoting an hour each morning for about six months to giving his men regular instruction. They can now do his estimating in excellent manner. He does not fear a competitor taking them away from him because, being trained in his ways, they are worth more to him than to anybody else. So he expects them to stay with him until they are ready to go into the contracting business for themselves.

Having told my tale and its sequel, I will leave your readers to draw from it their own moral.

TRAVELER.

En Route, Mar. 25.

The Status of the Engineer Again

Sir—Notwithstanding what Professor Swain says (ENGINEERING NEWS of Feb. 25, 1915, p. 409), the status of the engineer is not, in the opinion of many, what it should be. As a rough-and-ready means of comparison of the status of lawyers and engineers take the matter of the offices they maintain. In my own town, a city of about 125,000 population, you can count on the fingers of one hand the engineers who maintain offices *as engineers*. Lawyers' offices exist by the score. And how are the respective offices furnished? Step into the engineer's office, which may be one corner of a real-estate firm's quarters. In one corner is a pile of "junk," his "tools," as those who have not come to value highly his professional standing call them. There is a dust-covered drawing board yellow with time and scored with knife cuts, supported by pine horses also old and yellow. The bare floor of the office may have been painted once, but the tracks of muddy shoes are what now show plainest. Maybe a "Gurley's Manual" and an old copy of "Trautwine" lying around somewhere show you that it is an educated man whose sanctuary you have entered, and this is his library. No one is in; the proprietor is out "at work."

Now go for legal advice. The reception room you enter has a velvet rug; the furniture is of quartered oak. A young lady stenographer who is busy typewriting a "brief" (save the mark!) informs you that Mr. Blackstone is in his private office in the adjoining room, engaged with a client, but if you will have a seat and wait an hour and a half you can see him if you can send in a card bearing a name that has a rating in Dun or Bradstreet.

Of course, as he was your classmate at college and you took engineering and he law, and your class standing in the studies common to the two courses was better than his, you begin to wonder "upon what meat does this our lawyer feed that he is grown so great"; but you console yourself by thinking "the human element in the problems of the day can not be met by men who are mathematicians." If, poor fellow, the engineer had had the liberal training the lawyer had, and a personality, he, too—poor ignoramus!—could be a leader in the world of affairs!

Tommyrot! What engineer is there that is not 99% man and 1% mathematician? And when one has sat in the courtroom and heard a college-educated lawyer make a 24% grade into a 24° slope by substituting the one word for the other (not to his disadvantage in his argument, mind you, for 24° equals 44%, and he needed that slope to be steep to win his case), then one can appreciate Professor Swain's remark that the lawyer was trained to "pick words to express exact meaning," while Mr. Engineer lacked "similar exactness."

But the point I wish to come to is this: In the last issue of the list of members of American Society of Civil Engineers, all practicing engineers (I use the term for lack of a better) are put down as "Consulting Engineers," *even the Juniors*. Now, I had always hoped that by the time I reached three score and ten maybe I would have acquired enough experience to make my opinion worth something and that some younger engineer would consult with me that good day and I would be a consulting engineer. And I have thought that some of these young engineers who styled themselves "consulting engineers" as soon as they left college and started practicing for themselves were premature in adopting the title; but now the society which has more genuine consulting engineers in it than any other had adopted the usage; so it must be right. I protest, nevertheless.

CIV. ENGR.

March 23, 1915.

Specifications for Bituminous Cements

Sir—The editorial in ENGINEERING NEWS of Apr. 1 on "Specifications for Bituminous Cements" suggests comment. You speak of the difficulties of an engineer who finds it almost impossible to draw specifications open enough to admit of competition and yet describing the material wanted.

These difficulties are almost wholly imaginary; at least they may be easily overcome by the simple expedient of drawing alternate specifications. In other words, in road or pavement specifications under the general heading of asphalt or bituminous materials the engineer may include specifications calling in unmistakable terms for the principal classes of bituminous materials—the natural asphalts, the oil residuals and even blown products.

Bids are received which specify which class of materials the contractor proposes to use; or he may give a separate price—as it is most likely he will do—on each class of materials. The engineer may then decide which of these bids is the best one; and the best one will, of course, not necessarily be the lowest. Washington, D. C., among other places, has followed this policy for at least ten years, and is claimed to have the best asphalt pavements in the United States.

The engineer is not lessening competition by this means; he is increasing it. The idea that competition is increased by drawing wide-open specifications which admit anything and everything, the higher priced as well as the cheaper materials, is one of the strangest fallacies that ever entered the human mind. What happens under wide-open specifications is that a monopoly is conferred upon the cheapest, and presumably the most inferior, materials. The alternate specification is growing in favor because of these facts; and if experience counts for anything, this form of specification will be universally used within a comparatively short time.

The point you make as to the limited amount of faith that "experts" have in their own specifications is well

taken. Further criticism might be made as to the "previous-service" rule, which is ridiculous in view of the fact that under one trade name wholly different materials may be marketed from year to year. In other words, the fact that a product has been on the market for two years or more under one name does not mean that it is the same thing. One road binder on the market has been made out of four different crude oils in the last four years.

D. T. PIERCE,
Executive Assistant,
Barber Asphalt Paving Co.

Philadelphia, Apr. 3, 1915.

Tie-Rods in Tile-Arch Floors

Sir—The criticism of the design, or rather lack of proper design, of tie-rods for terra-cotta floor arches, given by Frank N. Kneas in your issue of Mar. 18, is, I think, very much to the point.

The writer while Chief Engineer in charge of engineering design in the Supervising Architect's office began with properly designing tie-rods to carry the actual arch thrust and used frequently for long spans up to 7/8-in. upset tie-rods, but found so much opposition from the fabricating shops that he was finally induced to accept the usual standard of putting in 3/4-in. tie-rods at a spacing of 4 to 5 ft., although the tie-rods with this spacing were often strained up to the elastic limit.

It had been the practice in the Supervising Architect's office to use tie-rods only in the last panel adjoining the outside wall or some stairwell or other opening. Under these conditions the writer had occasion to test an interior panel located about midway between the outer wall and an interior opening. At a comparatively small load, probably about 400 lb. per sq.ft., the arch began to settle rapidly. Investigation showed that the beams against the stairwell and the channel, which was about 1 in. from the exterior wall, had bent horizontally, allowing the two beams which supported the test arch to spread. After carefully wedging the wall channel with slate against the wall and driving a strut between the two beams of the stairwell, the loading was continued until the arch finally failed at a burden of something like 1200 lb. per sq.ft.

This illustrates clearly that there is an actual arch thrust, and that the only reason that no accidents happen in heavily loaded buildings is that the outside walls are sufficiently strong to resist the thrust transmitted from one arch to another and into the wall.

The provision of the "New York Building Code" that makes the spacing of the tie-rods dependent on the depth of the beam (up to a maximum spacing of 8 ft.) is extremely wrong. Deeper beams at the same time are usually spaced further apart, as the arches generally are deeper for such beams; but, as the arch thrust increases with the square of the distance between centers of beams and is reduced by the effective depth of the arch, it is plainly wrong to allow a wider spacing of tie-rods for the deeper beams.

It would seem to the writer that the only proper way is to proportion the tie-rods to support the calculated thrust from the arch, but to allow a high strain per square inch (probably as much as 24,000 lb.) on the tie-rods, since there are many elements that help to reduce the effective stress.

GUNVALD AUS.

11 E. 24th St., New York, Mar. 31, 1915.

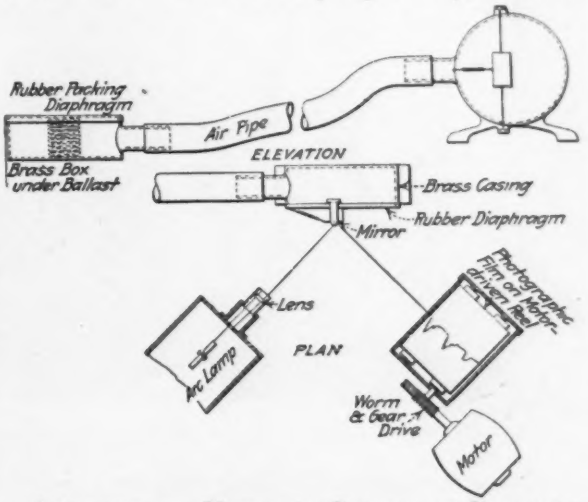
NOTES AND QUERIES

In the article on "The Turbines of the Cedars Hydro-Electric Development" in "Engineering News," Apr. 1, 1915, a paragraph giving credit for the design and construction was omitted by mischance. Both main and auxiliary units, with thrust-bearing supports, were designed by the I. P. Morris Co., of Philadelphia. Six units were built by the I. P. Morris Co. and three by the Wellman-Seaver-Morgan Co., of Cleveland. All the governor equipment was designed and built by the I. P. Morris Co. The generators were built by the General Electric Co., of Schenectady.

Measuring Stresses in Railway Roadbeds

An instrument for measuring the pressure of ballast on roadbed under traffic has been devised by J. R. W. Ambrose, Chief Engineer of the Toronto Terminals Ry., of Toronto, Canada, and is described briefly in the 1915 report of the American Railway Engineering Association's Committee on Roadway. It is shown in the accompanying view.

Under the track is placed an air-tight box, the upper side of which has a movable diaphragm. A spring within



APPARATUS FOR MEASURING STRESSES IN RAILWAY ROADBED UNDER LOAD

the box keeps the diaphragm in the extended position after the load is removed. This box is connected by a pipe or hose to a similar box placed on edge, and having a thin rubber diaphragm. To the center of this diaphragm a connection is made to the side of a small mirror; thus any deflection of the diaphragm is multiplied by the mirror. A ray of light thrown on the mirror is deflected according to the magnitude of the impulse given the diaphragm in the first box. The sensitized film moving at a constant speed records the movements of the light ray. This method can be enlarged upon and made as sensitive as desired. It is only necessary to calibrate the instrument, when actual results may be obtained.

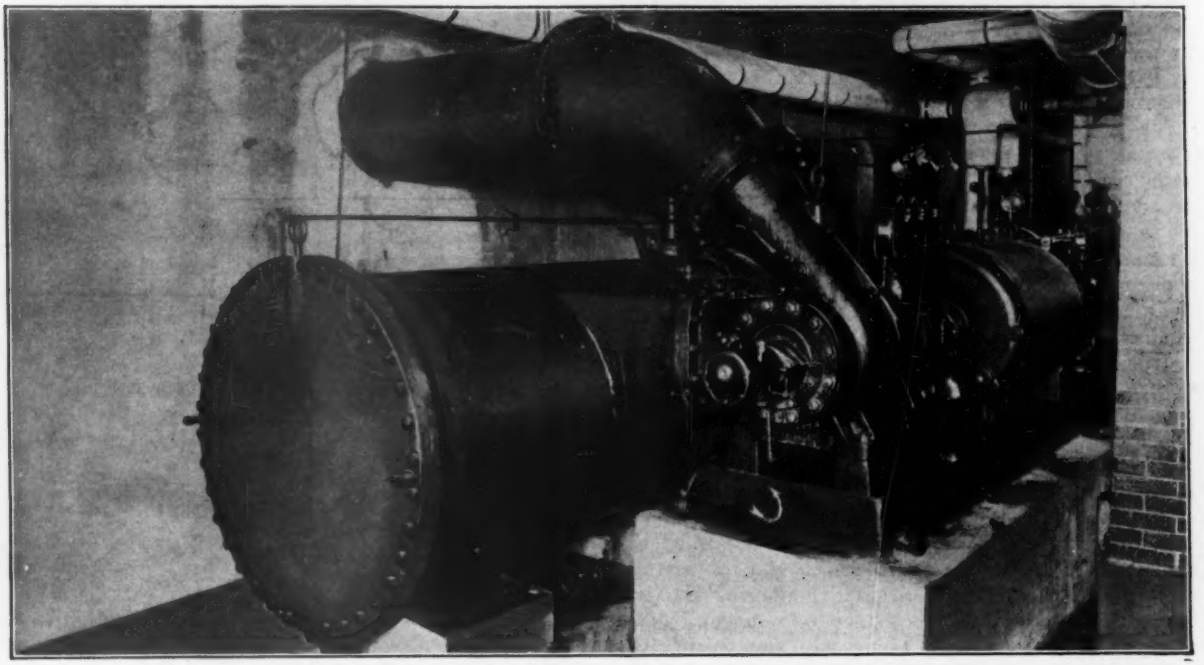
In the experiments, the transmitter box was 12 in. under the tie, covered with gravel ballast. The recording mechanism was located 300 ft. from the track, which resulted in a broken curve, due to the inertia of the air in the tube. With a test-house located adjacent to the track, this difficulty would be overcome and the instrument would be much more sensitive.

Water-Supply Booster Pumps; Roseland Station, Chicago

Installation and tests of two complete booster-pump units were recently completed in the Roseland pumping station of the city of Chicago. The maximum duty attained was 73,000,000 ft.-lb. per 1000 lb. steam, at a capacity of 5,120,000 gal. per 24 hr.

These pumps raise water-main pressure for the high-level service in the Washington Heights section. Water is taken at 50 to 60 lb. per sq.in. pressure and raised to 87 lb. maximum. The pumps are required to maintain the 87-lb. head in a 30-in. discharge main regardless of the suction pressure. The design used was a special 14-in. single-stage double-suction screw-impeller type with volute casing. A longitudinal section through one pump is shown in the accompanying sketch. The impellers have helicoidal vanes whose angles are fixed from point to point so as to secure shockless entrance of the water and a definite energy distribution over the whole vane. This design in factory tests has shown efficiencies up to 77% for moderate capacities (2000 to 4000 gal. per min.) and increased values for larger sizes. Each pump is driven by a 115-hp., 2750-r.p.m., multi-stage impulse steam turbine with speed and pressure governors to hold constant pressure on the mains regardless of capacity or suction pressure. Each pumping unit comprises also a water-works condenser, a flywheel-type air pump, with hotwell pump attached, and an atmospheric relief valve. The principal dimensions of this equipment are given in the accompanying table.

In the contract under which this machinery was furnished, each unit was guaranteed to develop a duty of at least 67,000,000 ft.-lb. per 1000 lb. steam (98% dry and 170 lb. per sq.in.) when pumping at a rate of 5,000,000 gal. per 24 hr. against 85-ft. head (not including friction). In the official tests, accurate determination was required of quantity of water, total head, and steam consumption, quality and pressure.

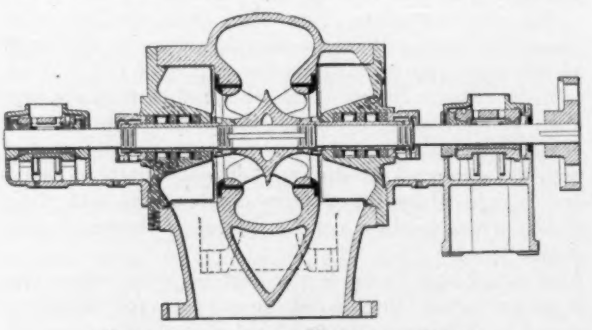


ONE OF THE 5,000,000-GAL. BOOSTER PUMPS, ROSELAND STATION, CHICAGO

DATA ON ROSELAND PUMPS

Main Pump and Turbine—	
Suction inlet	13x13 in.
Discharge outlet	14 in. diameter
Steam inlet	2½ in. diameter
Exhaust outlet	12 in. diameter
Overall dimensions	10 ft. long, 3 ft. 3 in. wide
Impeller	7¾ in. diameter
Condenser—	
Water outlet	13x13 in.
Water inlet	20 in. diameter
Steam inlet	12 in. diameter
Air-pump suction	4 in. diameter
Tubes	192—1¼ in. by 6 ft.
Shell	7 ft. 8 in. long; 3 ft. 5⅛ in. inside diameter; 3 ft. 7⅝ in. outside diameter
Air Pump—	
Steam cylinder	5 in. diameter
Air cylinder	12 in. diameter
Common stroke	10 in. diameter
Hotwell Pump—	
Plunger	3½ in. diameter
Stroke	4½ in. diameter

Each unit was subjected to a trial run of 12 hr.—for 4 hr. close to guaranteed capacity and for 1 and 2 hr. at various capacities above and below this figure, so as to give points on a characteristic curve.



SECTION THROUGH ROSELAND PUMP

To secure the desired rates of flow and freedom from

surges, the discharge piping was isolated from the high-pressure mains and returned to the low-pressure system through cross-over valves manipulated as indicated necessary by a pitometer. All the usual engineering precautions for accuracy were observed. The air pumps were operated condensing and the water was weighed in with the turbine condensate. The pumpage was measured by a 30-in. Venturi meter (part of the permanent installation). To eliminate the effects of pulsations in the suction line on discharge head readings, suction and discharge connections were run to a common mercury U-tube.

One pump showed an official duty (corrected to contract conditions) of 73,000,000 ft.-lb. per 1000 lb. steam and a capacity of 5,120,000 gal. per 24 hr.—exceeding the guarantee by 8.95% in duty and 2.40% in capacity. The second pump showed 71,000,000 ft.-lb. duty and 5,280,000 gal. duty—an excess of 5.97% and 5.60% respectively.

Water-Works Farming and Forestry by Los Angeles

By Burt A. Heinly*

In securing and protecting the waters of the Owens River and thirty-five tributary streams which supply the flow of its Aqueduct, Los Angeles, Calif., bought more than 100,000 acres or 150 sq.mi. of land in the Owens Valley, 240 miles north of the city. Results already accomplished in forestation, farming, hog and cattle raising on this land prove conclusively what can be done in a practical way by a municipality which is desirous of putting its properties to practical account.

Climate and Land—The Owens Valley, from an elevation of approximately 8000 ft., slopes southward to the shores of Owens Lake at an elevation of 3500 ft., the Sierra rising to a height of 13,500 ft. on the west and the barren Inyo range rising to nearly that height on the east. The average annual precipitation on the valley floor is about four inches. The temperatures range from 0 to 105° F., with likelihood of killing frosts in early spring. The soil varies from a loam to a heavy clay impregnated with alkali. Alfalfa, corn, rye and fruits of the temperate zone are best adapted to valley conditions.

Farming and Hog Raising—Much of the 100,000 acres has been leased in parcels ranging from 80-acre farms to ranches of from 4000 to 18,000 acres. The leases run from one to five years and are made upon competitive bids.

One farm of 720 acres has been run by the city as a municipal farm since 1908. The property was purchased in a little-improved state at a cost of $10 per acre. Today the value is conservatively placed at $100 per acre. During the fiscal year, sales of hogs from this farm amounted to $7000, three out of five carloads bringing 1c. per lb. above the market price. Hay and grain, sold to the Aqueduct Bureau at market rates, brought in $3000 more. With an operating cost of $7000, the farm for the year showed a profit of $3000.

As farm superintendent the Water Department in 1908 sent a young man, George Shuey, into the Owens Valley. Mr. Shuey had received the degree of civil engineer from the University of California and had taken a course in irrigation engineering, but best of all he knew practical farming because he was raised on a farm. He receives a salary of $150 per month and has general supervision of all city lands and works of improvement in the valley. On the city farm, the foreman, who has the use of a house, receives a salary of $85 per month. Additional help varies from one to 15 men, at $2.50 per day.

Of the 720 acres, 150 acres is in alfalfa, 100 acres in barley and corn, 60 acres in locust trees and the rest is in grazing land. Breakage of the land costs $10 per acre, leveling and bordering from $10 to $25 per acre and for two years thereafter, little more can be expected from the land than that it will pay a small margin over its cultivation. Each year sees the cultivated area slowly extended, as the property from the start has been required to pay its own way.

The city's farm superintendent has been able to show the settlers that they were not only wasteful in the use of water but also that their methods of profuse application of water were even harmful. The system of "bordering" (two 10-in. furrows every 50 ft., a quite common method elsewhere) was not employed in the Owens Valley until the city gave it practical application. Today the settler is leveling, ditching and bordering his land and the farm superintendent's services in this direction and in the general scientific handling of the land are sought by the settlers throughout the valley. In hog raising, also, the city has shown the profits that are possible. The valley has become interested and the city, to help in the movement and keep out disease, is furnishing the breeding stock, so far as it is able, and advising as to its care. While less attention to cattle has been possible, here also the city is endeavoring to grade up the stock.

In the operation of the city farm, there is a very determined effort to have it serve as a practical object lesson. Buildings are of a plain, substantial character.

Forestation—Forestation was undertaken five years ago with the intention of making it an important part of the city's extensive plan for placing its valley holdings on a profit-paying basis. Lying along the floor of the valley and at a slightly lower elevation than the aqueduct, so that irrigation is possible, the city owns 15,000 acres in one piece which is of little value and which, in addition to other tracts, it is desired to put into trees of commercial value. After a study of climatic and soil conditions, in which the United States Forest Bureau gave invaluable assistance, the black locust (*Robinia pseudacacia*) was selected.

In March, 1911, the city procured 50,000 locust seedlings from an Illinois nursery and planted a 60-acre tract on the city farm. In the following year it procured 150,000 seedlings of the same variety and began the forestation of the large tract previously mentioned. In addition, a nursery was established for the propagation of the California black walnut.

Opportunity for converting the waste land into capital is large, but money is required to do it, and the necessity for large expenditures on aqueduct works near the city has prevented the further use of funds to this end. For the present, commercial forestation has ceased but it has not been lost sight of. Experiments with varieties of trees new to the valley are under way; for instance, eucalyptus from Australia, that is inured to a moderately cold climate.

*645 South Olive St., Los Angeles, Calif.

Powdered-Coal Fire at Burden Iron Works, Troy

On Mar. 18, at 10 p.m., a fire occurred in the puddling-furnace building of the Burden Iron Co., at South Troy, N. Y. This the newspapers erroneously called an explosion due to powdered coal.

There were about 80 puddling furnaces here, and about one-fourth were using powdered coal as fuel. There was the usual milling plant, containing pulverizers, crushers, driers and the necessary bins and elevators. The pulverized coal was carried from the milling plant to the several furnaces by screw conveyors. At each puddling furnace there was a 1-ton steel bin with the requisite motor and controller to inject the fuel into the furnace.

The plant was running night and day, and the powdered-coal plant (furnished and erected by the Quigley Furnace & Foundry Co., of Springfield, Mass.) had been in operation since last fall. There had been the usual troubles with new machinery, but these had all been successfully overcome except one. The powdered coal persisted in caking in the bins, so that at times there was none flowing into the controller. This compelled constant hammering on the bins. Some become so battered that this hammering had been forbidden by the management a week or so previous.

On the night of the fire the operator at one furnace (*D* in the sketch) had removed the small slide from the foot of the hoppered steel bin, thinking, no doubt, that the coal would move more freely into the controller. But the coal dust was leaking out in small quantities upon the floor. There was a strong breeze blowing at the time, and as all the doors on the side walls were open, puffs of wind blew little clouds of this leaking coal dust in front of the furnace door (as at *F*). As the operator was pulling out a heat, with slag falling at his feet, the coal dust became ignited. Instantly, there was a flash and the flame darted upward into the roof trusses. These were wooden trusses with comparatively large surfaces, covered with fine coal dust which had settled there. The whole roof quickly became ablaze, and the men had to drop their tools and run for their lives.

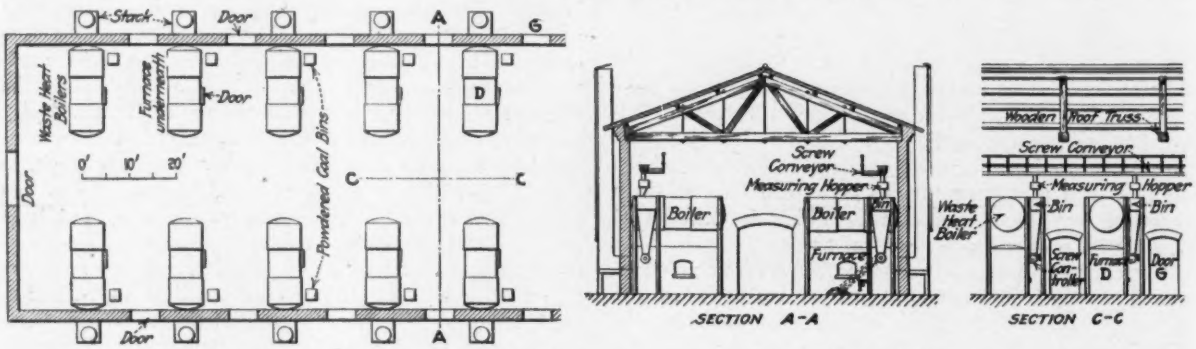
The fire burned from 10 p.m. until 2 a.m., when the roof fell in on the furnaces. A part of the building had steel trusses and did not burn. The measuring hopper, screw conveyors and walkways came down with the roof, but there was no back-flash of coal dust through the conveyors, nor was there any explosion of coal dust. The destruction is to be charged to employees rather than to equipment.

Increasing the Capacity of the Winnipeg Municipal Electric Works

In 1913 the growth of load on the Winnipeg municipal hydro-electric system demanded an increase of generator equipment beyond that of the initial development. There were then five 3750-kw. units, and two 66,000-volt transmission circuits on a single line of steel towers. (This plant was described in ENGINEERING NEWS, July 4, 1912.) It was originally intended to add two more generators, and two more transmission circuits on a second tower line; but by 1913 it became obvious that advance in turbine design made possible the installation of larger-capacity units in the existing wheel pits, and it was decided to add three 5100-kw. machines (three pits were available, since one of the old units had been permanently installed on a testing flume). Two of the new machines are now in place, and the third is about to go in. When this increase in capacity fails to satisfy the load demands, then the older units will be replaced without further changing the buildings or hydraulic works.

The increase in capacity of the transmission circuits was a more serious problem. The present redevelopment yields a total of 40,800 kw. and the ultimate possible development is twice that. Six circuits would be required to handle this output with the nominal received potential of 55,000 volts. The right-of-way is not suitable for the three power lines required without expensive reconstruction of foundations. It was found possible to satisfy immediate requirements by the construction of a new two-circuit power line suitable for 100,000-volt operation, but to be worked for the immediate future at 60,000 volts in parallel with the present line.

However, the alternative scheme was considered and adopted, of controlling line-voltage drop and rise by the use of unloaded synchronous motors to supply lagging or leading current as the loads demanded. (The theory and practice of using reactors were described by R. A. Phillip in ENGINEERING NEWS, Mar. 4, 1915.) Two 6000 kv.-a. synchronous motors, running at 600 r.p.m., 6600 volts, with three-phase transformers and automatic regulator equipment, were installed. These two machines change their field excitation to maintain the terminal line voltage constant, but permit manual shifting of the automatic regulator settings. The regulation of the line at light loads is secured without larger reactors on account of the low power factor of the off-peak loads help-



ARRANGEMENT OF POWDERED-COAL FURNACES AT BURDEN IRON WORKS

ing to overcome the tendency to excess voltage rise. The design and operation of the transmission system under the new conditions have been described at length by L. A. Herdt and E. G. Burr in a recent paper before the Canadian Society of Civil Engineers.

Landslide on the Kanawha & Michigan Ry.

A landslide on the Kanawha & Michigan Ry., in the mountains of West Virginia, caused a train wreck on Feb. 4. For the accompanying information and view we are indebted to C. M. McVay, Engineer of Maintenance-of-Way. The slide occurred about 5 a.m., at a point about half a mile south of Longacre, W. Va. It struck the head of a passing freight train, causing the engine and two cars to run down the bank into the Kanawha River, landing at about right angles with the track. The view shows the slide, with two 100-ton wrecking cranes at work hauling out the locomotive.

LANDSLIDE ON THE KANAWHA & MICHIGAN RY. NEAR LONGACRE, W. VA.

The slide occurred while a portion of the line was inundated from high water in the Ohio River, and it was necessary to run the steam shovel and work train through water 34 in. deep for two miles to reach the wreck. The shovel was put into the slide on the main track, casting dirt over the river bank. The main track was not damaged, the entire movement being from above and the ground underneath the track remaining unbroken. After 20 hours' digging the shovel had the main track cleared, but just as it was removed the ground slid again, covering the track and making it necessary to put the shovel through the slip again. After about 12 hours' more work the track was cleared and the ground above it sloped back. Since that time the slide has not moved.

Ditches have been dug around the top of the slide to keep water out of it as much as possible, and since these first movements it has been dry. The slide when first covering the track was 170 ft. long and 18½ ft. deep in the deepest place, the average depth over the rail being 12 ft. It is estimated that about 5000 cu.yd. of dirt and small rock were removed to clear the track and to trim the slope back so that it would stand.

The break occurred about 300 ft. above the track, and the entire slide contained about 40,000 cu.yd. It is believed that it was caused by the freezing and thawing of water in a crack in the formation on the side of the mountain. The slide has continued to break to some extent at the top, but has taken a good slope and no more trouble is expected.

The New Orleans Ratproofing Ordinances have been held valid by the United States District Court as a result of a property-owner's application for an injunction against their enforcement. (See U. S. "Public Health Reports," April 2, 1915, for decision in full, and same, Aug. 7, 1914, and Feb. 19, 1915, for details of ordinances and of ratproofing work at New Orleans.)

An Industrial Development Railroad has beeen planned for Jersey City, N. J., by F. Van Z. Lane, Consulting Engineer, acting on behalf of the Port Development Committee of the Jersey City Chamber of Commerce. The proposed line would have a main-track length of five miles, with 16 miles of siding. Its estimated total cost is $1,500,000. The road is planned to serve as a belt line, permitting interchange of cars between the several railways terminating in Jersey City and reaching a number of the principal steamship lines having piers there. It would also make available for factory and warehouse purposes large additional areas of land, which would be given direct track communication with the lines of the proposed railway. The project has been approved by the Jersey City Council and awaits the enactment of necessary state legislation.

News of the Engineering World

Railway Service Exhibition

A national railway service and supply exhibition will be given at Grand Central Palace, New York City, May 17-22, 1915, under the auspices and management of the Order of Railroad Telegraphers, Dispatchers, Agents and Signalmen. A prominent feature will be safety appliances. Applications to exhibit may be made to the Order, Temple Court Building, New York City.

Intake Pipes Break at Cedar Lake Reservoir, Seattle

The two wooden pipe lines (4 and 6 ft. in diameter) carrying water to the turbines of the municipal power and lighting plant at Seattle, Wash., were broken on Apr. 5 by a landslide about 800 ft. above the new Cedar Lake masonry dam, which was described in ENGINEERING NEWS, Jan. 21, 1915, p. 112. The masonry dam is about 6000 ft. below an old crib dam which, on account of leakage through the side walls of the new dam preventing sufficient head there, is still used to create the head for the power line. The break is in the pipe line lying along the bottom of the reservoir between the two dams in a depth of about 35 ft. of water. On account of the break it is necessary to operate the auxiliary steam plant of the city to full capacity.

Floats have been prepared, and from these divers are working making holes in the pipe to be used as intakes to operate the plant from the water stored behind the new dam until it is possible to draw off the water, repair the pipes and restore the old dam to its previous use. These pipes may be noted in the view on p. 113 of the issue of Jan. 21.

Work has been suspended in the attempt (noted in the previously cited issue) to make the reservoir hold water, pending the sinking of test holes into the morainal bank to ascertain the depth to bedrock. Rock has been found in several of these holes, and the latest advices are that it is now proposed to abandon the scheme of puddling the bank and to put in a thin concrete cutoff wall to a depth of approximately 200 ft. at a cost of from $1,000,000 to $1,500,000. The city engineer estimates that puddling would require about 3,000,000 cu.yd. of clay, which is very scarce in the vicinity, and the cost will be practically the same as for a cutoff wall. One test hole about a quarter-mile above the dam shows rock at 198 ft. and the hole was sunk 16 ft. into rock. Another hole about an eighth-mile above the dam shows rock at 220 ft., and one a half-mile above at 160 ft. Mayor Gill has declared in favor of the cutoff wall, but the other five members of the Board of Public Works advocate the puddle method. The City Council will probably be called upon to decide what is to be done.

If the cutoff wall is decided upon it will be necessary to vote on a new bond issue for this amount in addition to about $1,500,000 to be spent to make the water available for power. [Telegram from Charles E. Fowler, Seattle, Wash.]

Licensing Engineers in Pennsylvania

A special committee of the Engineers' Society of Pennsylvania appointed to consider the matter of licensing engineers has made a report, which is printed in the *Journal* of the Society for March. The following is a summary of the report as presented:

Your committee, appointed for the purpose of considering the subject of licensing engineers, begs to submit the following report:

We are opposed to any system of licensing engineers. We would not object to a system of licensing land and mine surveyors whose work forms a part of the public records of the boundaries of real estate. We would not object to a system of civil service certificates, tending to insure the competence and integrity of engineers responsible for the design and construction of public work, but this subject may be considered outside the province of this committee. If, however, it is decided that some form of licensing engineers is necessary, we would recommend that examinations be held and licenses issued under the authority of the state.

The principal objections to a system of licensing are as follows:

1. Defective engineering is caused at least as often by the parsimony of the owner or the fraud of the contractor or supply man as by the ignorance of the engineer.

2. If all engineers are required to hold licenses it might be construed that any wagon maker who built a new pattern of wheelbarrow or any carpenter who replanked a bridge floor should be punished for neglect to secure a license as engineer.

3. It hardly seems wise for the state to attempt to protect strictly private interests or to interfere with private affairs, except in the exercise of ordinary police powers, which are intended only to protect human life and health and the interests of the public.

4. If only the interests of the public are to be protected, which is the only excuse for public intervention, there are a very large number of cases in which it is impossible to determine beforehand whether they are seriously threatened or not, and it would often require a decision of the supreme court to decide whether an engineer was an honored citizen or a criminal.

5. If the public actually suffers there is no question of the hazardous character of the work and the responsibility of the engineer can best be determined by the extent of the damage.

6. It is well known that some repair work requires a higher grade of engineering skill and responsibility than was required in the original design of the structure, while other repairs require only ordinary mechanical skill. It would often be extremely difficult to differentiate between the cases.

Wm. B. McCaleb, D. E. Tracey;
Willis Whited, Chairman.

Control of Colorado River

Under the Congressional appropriation of $100,000, plus a like sum provided by the Imperial Irrigation District, work is in progress at two places to prevent damage from floods in the Colorado River.

Before General Marshall arrived to represent the Federal Government the Imperial Irrigation District had begun to enlarge and strengthen the Volcano Lake Levee, to prevent the discharge of water from it northward into the valley. General Marshall approved this work, plans for which had been made by C. R. Rockwood, Chief Engineer, Imperial Irrigation District, El Centro, Calif., before Congress appropriated the $100,000 mentioned.

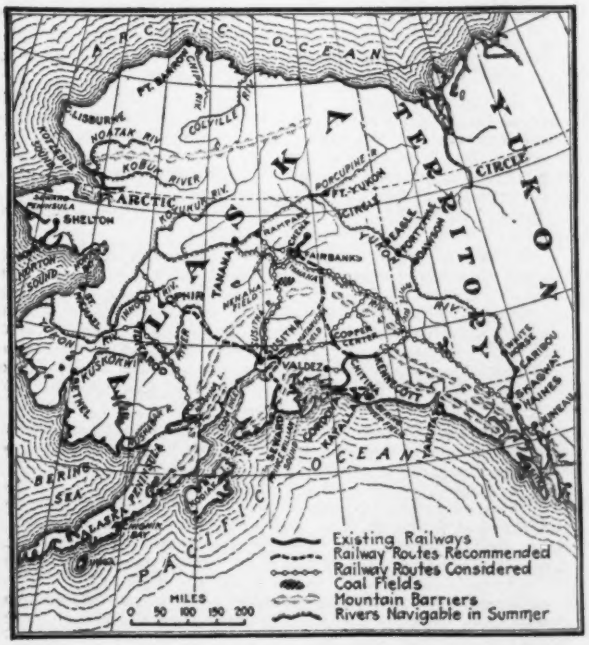
The original height of this levee was 6 ft. and its slopes were 2 to 1. It is being raised 4 ft., and the north slope is being made 4 to 1. The levee is eight miles long. The cost of the work will be $125,000. Mr. Rockwood has been appointed by General Marshall as engineer for the Government in this work.

The other work being done is the protection of the river front for a distance of seven miles south of the general heading of the Imperial Canal at Hanlon's, below Yuma. The river levees along this stretch were constructed by the California Development Co. a few years ago, but the river has cut into them so much that it is necessary to protect them. To this end 75,000 cu.yd. of rock at a cost of $75,000 is being added under the direction of General Marshall. It is expected that the rock will be placed by June 1.

In addition to the $100,000 which the Imperial Irrigation District has turned over to the Government, the district this year will probably expend $50,000 in protection work.

The Alaska Railway Route Selected

On Apr. 10 President Wilson announced that the Seward-Fairbanks line, known sometimes as the Susitna route, had been selected as the Government railway to be built in Alaska under the $35,000,000 appropriation of 1914. The route extends from Seward, on Resurrection Bay, to Fairbanks, on the Tanana River, a distance of 471 miles. It includes the existing Alaska Northern R.R.,



RAILWAY ROUTES IN ALASKA PROPOSED BY 1913 COMMISSION

(Government, under date of Apr. 10, 1915, adopted Seward-Fairbanks Route)

which runs from Seward through the Kenai Peninsula for a distance of 71 miles to Turnagain Arm. This branch is to be bought from its present owners by the Government for $1,150,000.

From Turnagain Arm the route is to be extended through the Susitna Valley and across Broad Pass to the Tanana River, and from there on to Fairbanks. It is to be a standard-gage road. A side line is to run from Matanuska Junction into the Matanuska coal field, a distance of 38 miles. The road is to be built with its present base at Ship Creek, on Cook's Inlet, and from this point it is expected that the Matanuska coal will be shipped during the greater portion of the year. The estimated cost of construction of this line from Seward to Fairbanks, including the Matanuska branch, is $26,800,000.

The accompanying map, taken from the abstract of the report of the Alaska Railroad Commission in ENGINEERING NEWS, Mar. 20, 1913, p. 564, shows not only the accepted route, but also the other routes suggested by the commission. It may be remarked that for an initial line the commission recommended the Cordova-Fairbanks line over the route now adopted.

Wm. C. Edes, of the Alaska Engineering Commission, has been designated chairman, to be in immediate charge of work and to have power of approval or disapproval of all administrative matters. Lieutenant Mears and Mr. Riggs, the other members of the commission, are now on their way to Alaska to take up the construction and survey work. It is expected that about 40 miles will be built during the coming year at a cost of $7,900,000.

Municipal Garbage-Disposal Situation in Chicago

The people of Chicago have voted in favor of a bond issue of $700,000 for improving the garbage-disposal system. Of this amount about $385,000 will be used for extensions and improvements of the present reduction plant at 39th and Iron St., including a new mill building ($105,000), new drier building ($72,000), scrubber ($12,000), office building, machine shop, cranes and mechanical equipment. The next largest item will be $170,000 for completing the new incinerator at 95th St. and E. Stony Island Ave. This is to take care of garbage from the district south of 65th St., the haul to the 39th St. plant being too great, and the present method of disposal by dumping into swamps and holes being unsatisfactory. Other items besides the two noted above are as follows: $75,000 for the Goose Island disposal plant (not yet located definitely); $70,000 for motor trucks, river barges and other transportation equipment; $30,000 for the technical staff, and $15,000 for completing the Bridewell crematory at 26th St. and California Ave.

The present garbage-reduction plant at 39th and Iron St. was purchased from the Chicago Reduction Co. on Jan. 29, 1914, after considerable controversy over the valuation, and the company had shut down the plant rather than continue its operation following the expiration of the franchise in 1913. The plant was improved and overhauled by the city, and its municipal operation under the direction of the Department of Health commenced on June 11, 1914. The city paid $275,000 for the plant, besides $4689 for expert fees in connection with the purchase, and then spent $392,667 in rebuilding and improving it. The operating expenses for labor, supplies and repairs during the 11 months of municipal ownership in 1914 amounted to $129,498, while the revenue for the six months of municipal operation was $113,707. During this six-month period the plant han-

dled 78,531 tons of garbage and produced 19,388 tons of commercially dried garbage. With the present facilities it is found impracticable to separate the grease from the product without causing offensive odors, but the additions to be made to the plant will enable the grease to be separated and recovered.

A Street Cleaning Department Pier Burned in New York City at 7 a.m., Apr. 11. The pier was damaged to some extent and two scows were burned.

Ornamental Statues for Manhattan Bridge, New York City, will soon be placed in position on the Brooklyn approach. The statues represent Brooklyn and Manhattan and were modeled by Daniel Chester French. They will be placed on white-granite pylons. The statues are 12 ft. high and cost $9000 each.

The Fortune of the Late Thomas C. Keefer, the famous Canadian engineer, was nearly half a million dollars. The principal heir is Thomas C. Keefer, Jr., a son. By the terms of the will an acre of the estate at Thorold, Ont., is set aside for the erection of a monument to William Hamilton Merritt, builder or rather promoter of the Welland Canal.

The Materials Used for Water-Works Service Pipes, the method of installing and paying for them and various other phases of service pipes are the subject of an inquiry blank now being sent out by a committee of the New England Water Works Association, headed by William S. Johnson, Chairman, 101 Tremont St., Boston, Mass. Copies of the blank can be obtained by applying to Mr. Johnson.

"Typhoid Mary," a bacillus carrier discovered in 1907 by George A. Soper, Consulting Engineer, New York City, has again been detained at North Brother Island by the Department of Health of New York City. After it had been learned that the woman had, while acting as cook, given rise to many cases of typhoid fever in various places she was detained for three years, despite two attempts to secure court orders for her release. In 1910 she was given her freedom ("Bulletin" of the New York City Department of Health, April 2, 1915) on her promise not to hire out as a cook and to use all precautions to prevent the occurrence of typhoid infections. She soon broke her parole and has since been the alleged cause of two cases of typhoid in a private sanatorium where she was employed and of 25 cases among nurses and doctors in the Sloane Hospital for Women, New York City.

Building Materials Produced by British Columbia, Can., in 1914—The output of structural materials such as cement, lime, building stone and other clay products in British Columbia, Can., in 1914, was much below normal, according to a recent report by the Provincial Bureau of Mines, because of the cessation of building operations brought about by the uncertain financial outlook and scarcity of money for investment and by the war. The value of such materials produced in 1914 is estimated at about $3,000,000, a serious decrease from the preceding year, but not as great as it would have been except for the large government contracts being carried on at Victoria at the breakwater and piers at Outer Wharf, which required a large amount of stone. Two new marble quarries were opened up on the southern end of Texada Island, but it is too early to expect anything more than sample shipments from them. The output of cement has decreased. A cement plant near Princeton has shut down.

PERSONALS

Mr. Oscar Wenderoth, of New York City, has resigned as Supervising Architect of the U. S. Treasury, the resignation to take effect June 1.

Mr. J. P. Rapp, steel wheel specialist, has resigned from the Forged Steel Wheel Co. and allied concerns, and has been appointed Vice-President of the Gulick-Henderson Co., Pittsburgh, Penn.

Mr. Perry Shumaker has been appointed City Engineer of Xenia, Ohio, to succeed Mr. Levi Riddell, recently resigned. Mr. Shumaker has been employed with the engineering staff of the Pennsylvania R.R.

Mr. C. D. Schlemmer, a civil engineer and surveyor, of Islip, N. Y., has been elected Superintendent of Highways of the Town of Islip. He was formerly with the engineering staff of the Board of Water Supply of the City of New York and on the Panama Canal work.

Dr. Pierre de P. Ricketts announces the dissolution of the firm of Ricketts & Banks, New York City. Mr. Ricketts will continue his practice as a consulting chemical and metallurgical engineer under the name of Ricketts & Co., with offices at 80 Maiden Lane, New York City.

Mr. Charles U. Powell, First Assistant Engineer of the Topographical Bureau of the Borough of Queens, New York City, has been placed in temporary charge of that bureau to fill the vacancy caused by the appointment of Mr. Clifford B. Moore as Consulting Engineer of the borough.

Mr. Alfred Kauffmann, who for several years past has been connected with the Sales Department of the Link-Belt Co., Philadelphia, giving his attention particularly to the coal-mining side of the business in the East, has been made Vice-President in charge of operation at Indianapolis, Ind.

Mr. W. Purves Taylor, Assoc. M. Am. Soc. C. E., Assistant Engineer of the Philadelphia Bureau of Highways, has been appointed Principal Assistant Engineer to succeed Mr. William D. Uhler, M. Am. Soc. C. E. Mr. Taylor was born and educated in Philadelphia, and for many years has been in the city's service.

Mr. J. H. Clark, Superintendent of Floating Equipment of the Baltimore & Ohio R.R., at Baltimore, has received the additional appointments of Assistant General Superintendent of the New York division and General Superintendent of the Staten Island lines, with headquarters at St. George, Staten Island, N. Y.

Mr. Osborne J. Dempster, M. Am. Soc. C. E., has resigned as City Engineer of Little Falls, N. Y., to accept a position with the New York State Highway Department. Mr. George I. Oakley, Assoc. M. Am. Soc. C. E., Resident Engineer at Little Falls of the New York State Barge Canal, will succeed Mr. Dempster.

Mr. Clifford B. Moore, Chief Engineer of the Topographical Bureau of the Borough of Queens, New York City, has been appointed Consulting Engineer of the borough, to succeed the late J. Foster Crowell. The salary of the position is $7200. Mr. Moore was born at New Rochelle, N. Y. He has been in the city's service since 1900.

Mr. William D. Uhler, M. Am. Soc. C. E., since 1912 Principal Assistant Engineer of the Philadelphia Bureau of Highways, has been appointed Chief Engineer of the Pennsylvania State Highway Department, to succeed Mr. Samuel D. Foster, M. Am. Soc. C. E. His salary as Chief Engineer will be $7000 a year. Mr. Uhler was Engineer of Maintenance of the Maryland State Road Commission from 1908 to 1912.

Mr. Samuel T. Wagner, M. Am. Soc. C. E., Assistant Engineer of the Philadelphia & Reading Ry., has been appointed Chief Engineer of the company to succeed the late William Hunter. Mr. Wagner was born in Philadelphia in 1861, and is a graduate of the University of Pennsylvania. He started his engineering experience as draftsman with the Phœnix Iron Co., and entered the service of the Philadelphia & Reading Ry. as Assistant Engineer in 1902.

Mr. Frank Puglia, a contractor, of Paterson, N. J., and Messrs. Nicholas, Michael and William Cervino, announce that the contracting business formerly conducted by Mr. Puglia in Paterson has been incorporated under the name of the Sanitary Construction Co., with the following officers: President and Treasurer, Frank Puglia; First Vice-President, Nicholas Cervino; Second Vice-President, Michael Cervino; Secretary, William Cervino. The offices of the company will be at 34 Cross St., Paterson.

Mr. Charles E. Dole, Chief Clerk of the Purchasing Office of the Panama Canal, has been appointed Purchasing Agent for the Alaskan Engineering Commission. Mr. Dole is a native of Mattoon, Ill. From 1897 to 1901, he was connected with the operating department of the Chicago, Cincinnati, Cleveland & St. Louis R.R., attached to the purchasing office. After four years in the Office of the Secretary of War, he was transferred to the Isthmian Canal Commission, where he became Chief Clerk, in 1906, which office he has held ever since. The Purchasing Office of the Alaskan Engineering Commission will be situated at the Alaska Bldg., Seattle, Wash.

OBITUARY

Lee Massengale, formerly a civil engineer in the employ of the Southern Traction Co., ended his life by taking poison at his home in East St. Louis, Apr. 2. He was 45 years of age.

Samuel Walton, a well-known railroad contractor in the South, died from heart failure at his home in Falls Mills, Va., Mar. 28, in his 70th year. Major Walton was a member

of the firm of Walton & Co., which built the Radford cutoff of the Norfolk & Western Ry., and had had numerous other contracts for that road, notably work on the Clinch Valley division.

Maurice Augustus Vielé, M. Am. Soc. C. E., President of the firm of Vielé, Blackwell & Buck, Construction Engineers, New York City, died in New York City Apr. 10, in his 49th year. Mr. Vielé was a graduate of Hobart College and the Massachusetts Institute of Technology. For many years he was in the employ of the General Electric Co., and during the Spanish-American War went to the front as adjutant of the volunteer corps of engineers. He was born at Geneva, N. Y.

W. J. McDonald, a prominent railroad contractor of Moulinette, Ont., died Apr. 5 at St. Petersburg, Fla., where he had been spending the winter for the benefit of his health. Mr. McDonald was for many years a partner in the firm of Ryan & McDonald, which built sections of the Grand Trunk Pacific Ry. in Quebec and New Brunswick, and was also connected with the Saguenay Construction Co., which built some of the most difficult parts of the Quebec & Saguenay Ry.

Thomas Middleton, for the past 20 years in the service of the Mississippi River Commission as Assistant Engineer in charge of the mechanical engineering department, died at his home in Webster Groves, Mo., on Mar. 29, from pneumonia. Mr. Middleton was born in 1838 at Liverpool, England. After receiving the usual collegiate training, he entered as apprentice to Lairds, of Birkenhead, during which period he was engaged on the construction of the "Alabama," of Civil War fame. In 1871 he went to Canada, where he was employed in marine engineering work, gradually becoming interested in dredging and excavating machinery. While in the service of the commission he designed a notable line of sand-suction dredges, many of the self-propelling type, as well as light-draft steamers and other floating craft.

F. Hopkinson Smith, Assoc. Am. Soc. C. E., author, artist and engineer, died at his home in New York City on Apr. 7 from a complication of diseases. Mr. Smith was born at Baltimore, Md., in 1838. At the age of 16 he started work as a shipping clerk. Subsequently he studied mechanical engineering. As a contractor he constructed for the government the seawalls around Governors' Island, in New York harbor, at Tompkinsville, Staten Island, and around the Race Rock lighthouse, off New London, Conn. Mr. Smith was, however, far better known as an artist and writer. His work has been on exhibition in the large art collections of this country, and he was the recipient of many medals from expositions and art clubs. Mr. Smith was perhaps best known, especially in later years, for his literary work, having written at least two dozen books, most of which have become widely known and enjoyed in this country and abroad.

ENGINEERING SOCIETIES

COMING MEETINGS

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION.
Apr. 22-23. Annual convention at Keokuk, Iowa. Secy., H. E. Weeks, Davenport, Iowa.

AIR BRAKE ASSOCIATION.
May 4-7. Convention at Chicago. Secy., F. M. Nelis, 53 State St., Boston, Mass.

AMERICAN WATER WORKS ASSOCIATION.
May 10-14. Annual meeting in Cincinnati. Secy., J. M. Diven, 47 State St., Troy, N. Y.

NATIONAL FIRE PROTECTION ASSOCIATION.
May 11-13. Annual meeting at Hotel Astor, New York City. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

CONFERENCE OF BUILDING INSPECTORS.
May 14. Meeting in New York City. Secy., Sidney J. Williams, Madison, Wis.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.
May 17-20. Annual meeting at Chicago. Secy., C. G. Hall, 922 McCormick Bldg., Chicago.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.
May 19. Annual convention at Galveston, Tex. Secy., H. S. Cooper, Dallas, Tex.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION.
May 20-21. Spring meeting at Atlantic City, at Hotel Marlborough-Blenheim. Secy., Charles E. Hildreth, Worcester, Mass.

MASTER BOILER MAKERS' ASSOCIATION.
May 25-28. Annual meeting in Chicago. Secy., H. D. Vought, 95 Liberty St., New York City.

NATIONAL DISTRICT HEATING ASSOCIATION.
June 1-3. Annual convention at Hotel Sherman, Chicago. Secy., B. L. Gaskill.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION.
June 3-4. Annual convention at Bellevue-Stratford, Philadelphia, Penn. Secy., F. D. Mitchell, 1510 Woolworth Bldg., New York City.

NATIONAL CONFERENCE ON CITY PLANNING.
June 7-9. National Conference in Detroit, Mich. Secy., Flavel Shurtleff, 19 Congress St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 9-11. Annual convention in Atlantic City. Secy., Jos. M. Taylor, Karpen Bldg., Chicago.

MASTER CAR BUILDERS' ASSOCIATION.
June 14-16. Annual convention in Atlantic City. Secy., Jos. M. Taylor, Karpen Bldg., Chicago.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.
June 17-18. Semi-annual meeting at Toledo. Secy., Frank E. Sanborn, Ohio State University, Columbus.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 22-25. Annual meeting at Iowa State College, Ames, Iowa. Secy., F. L. Bishop, University of Pittsburgh, Pittsburgh, Penn.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 22-25. Summer meeting at Buffalo, N. Y. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 22-26. Annual meeting in Atlantic City. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

Princeton Engineering Association—The annual meeting will be held at the Princeton Club, New York City, on Saturday, Apr. 17, at 8:30 p.m. It will be preceded by an inspection trip over Sections 1-A and 1, routes 4 and 38, of the new subway construction work.

Roanoke Engineering Club—At a recent special meeting of the Roanoke (Va.) Engineering Club, C. A. Mees, of Charlotte, N. C., Consulting and Designing Engineer for the Southern Power Co., delivered an address which included a description of the new Lookout Shoals hydroelectric station now under construction by the Southern Power Co.

Iowa Street and Interurban Railway Association—At the annual convention to be held at Keokuk, Iowa, Apr. 22-23, the following papers will be presented: "The Jitney Bus," C. I. Palm, Omaha & Council Bluffs Street Ry. Co.; "The Investigation and Care of Railway Circuits," F. V. Skelley, Tri-City Ry. Co., Davenport; "Arrangement of Schedules with a View to Providing Service During the Evening Peak," L. L. Sloss, Des Moines City Ry. Co., Des Moines. The Secretary is H. E. Weeks, Davenport, Iowa.

Engineering and Commerce Efficiency Society of America—This society was incorporated at Columbus, Ohio, on Apr. 2, by G. E. Burroughs, L. B. Passmore, Grover Schaible, Anthony Golubich and H. B. Frazier, of Pittsburgh and Cleveland, in behalf of a charter membership of about 1500 technical and commercial men living in Canada, the United States, Mexico and South America. According to G. E. Burroughs, Chairman of the Organization Committee, the objects for which the Society was formed are to promote discussion and dissemination of questions relating to administrative, productive and commercial efficiency, and to promote questions relating to domestic and foreign trade. A free information and statistical exchange will be maintained for the use of professional men. The Society will publish a monthly and a weekly journal, the first issue to appear May 1. The code of regulations states that "senior members shall be those who have been for five years in responsible charge of enterprises, the conduct of educational work or employed with one concern for that period of time; junior members shall be all others." The initiation fee for either class is $5; the annual dues, $1. The headquarters is in the Fulton Bldg., Pittsburgh, Penn.

Appliances and Materials

Grade Crossing Warnings

Railway crossing signals with moving attachments to make them more conspicuous and more likely to attract attention than simple fixed signs and lamps were a feature of the Railway Appliances Exhibition, held recently in Chicago. Some of these had swinging disks or arms, as described in "Engineering News," July 23, 1914. A new device of this type, shown by the Chicago Railway Signal & Supply Co., has projecting from the top of the post a horizontal rod or arm with a red steel banner, and as a train approaches this is swung up and down in imitation of the waving of a flag. At the same time flashing red lights are shown on the highway sides, and audible warning is given by a bell on the post, as in most other signals of this type. When the red lights are shown toward the highway, green flashing lights are shown on the railway sides, indicating to the enginemen of approaching trains that the signal is in operation.

Another form of highway crossing signal exhibited had a horizontal arm with a series of red lenses, the lamps flashing

in succession to give the appearance of a red light waving to and fro. To increase the visibility at night, some of the signs had lamps so placed as to throw a strong light on the lettered arms, while others had an arm with the word "danger" in glass letters illuminated from the inside by fixed or flashing lights.

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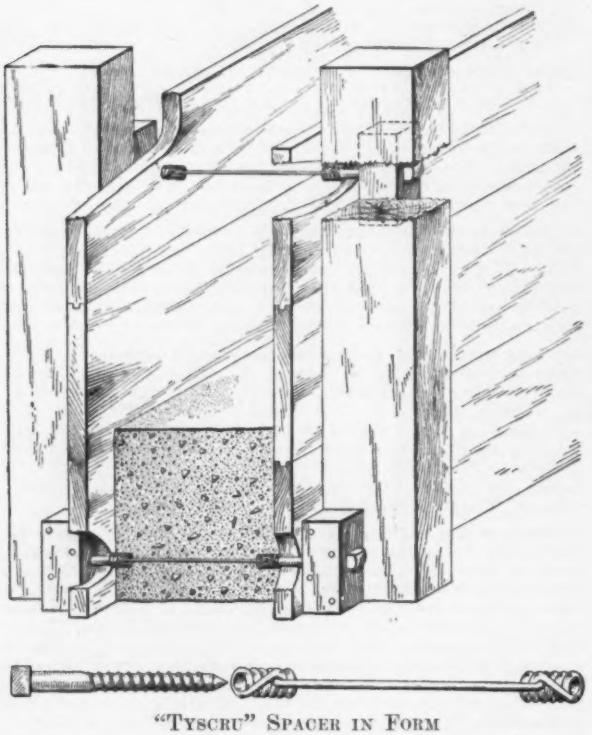
A Concrete-Form Spacer and Tie

The device shown in the accompanying sketches, known as "Tyscru," is being marketed by the Unit-Wall Construction Co., 1328 Broadway, New York, for use in concrete formwork only as a tie and spacer and as an anchor for the future attaching of machinery on structures. The spacer consists in a continuous wire, spiraled at both ends to provide



"TYSCRU" SPACER IN FORM

a bond in the concrete and a socket into which the form screws may be entered during construction and which after the removal of the forms serve as the female screw into which anchors may be fitted.

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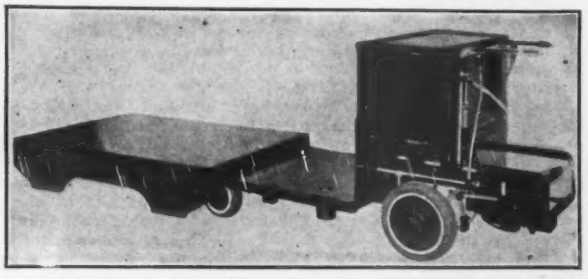
Storage-Battery Shop Truck

An electric motor truck with a false platform is a recent interesting shop development of the Buda Co., Chicago, Ill. As shown in the accompanying view, the battery box, motor and worm-gear drive are placed over one pair of wheels, adjacent to the operator's platform. By using a pair of small wheels at the opposite end, the floor can be set very low, which is especially convenient in handling heavy loads. The frame carries four hydraulic rams with their plungers normally flush with the truck floor. The load is put on a false platform which is just high enough to allow the floor



STORAGE-BATTERY TRUCK WITH FALSE DECK

of the truck to pass under it. When the truck is under the platform, the operator gives a few strokes to a convenient hand pump, raising the plungers and lifting the platform. Then the truck is run to the desired point, the hydraulic pressure is released and the platform is lowered to the ground, leaving the vehicle free for another trip. Trucks of the same type are built without the rams and false deck.

The operator stands on a rear platform with brake and circuit-breaker pedal. At his left is the horizontal hand lever for the controller, and at his right, the steering lever. A four-wheel steering gear is used, and the vehicle can turn in a radius of 5 ft. This truck is 8 ft. long and 3 ft. high; it weighs about 2060 lb., and has a load capacity of 4000 lb. It has three speeds in each direction (1 to 7 mi. per hr.). The false deck is 40x66 in. and 10½ in. above the ground.

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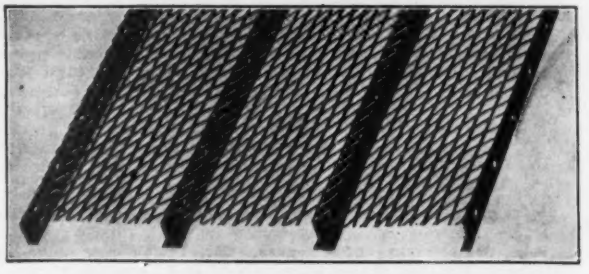
Expanded-Metal Ribbed Lath

A recent form of ribbed expanded-metal lathing is made by slotting and expanding the center portion of strips of metal, leaving on each side a solid portion which is afterwards bent back, forming a channel 4x1 in., with web of expanded metal. The edge of the flange is also bent inward about $\frac{1}{8}$ in. These channels are united in an interesting manner to form the sheets of lathing. They are placed together



RIBBED EXPANDED-METAL LATHING

with flanges downward and in contact, and are passed over a table having horizontal rotating disks fitted with punching and flattening devices. These punch holes about 2 in. apart through the adjacent flanges, the metal burr being flattened on the opposite side so as to clinch the pieces together. The lathing thus made can be produced in sizes up to 12x4 ft. It is manufactured by the Northwestern Expanded Metal Co., of Chicago, and is given the trade name of "Chanelath."

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Slide Rule for Heating and Piping Problems

A slide rule for computations in the design of steam and hot-water heating systems and steam-power piping has been developed by C. D. Allan, of Chicago, and is being made by Keuffel & Esser Co., of Hoboken, N. J. With it the relations of five variables can be ascertained—volume of flow, friction loss of pressure, pipe diameter, velocity of flow, temperature drop, etc. A manual accompanies the rule.

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Notary Public.
(My commission expires March 30, 1917.)